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Fire Effects on Cultural Resources
A Bibliographic Survey of Specific and Related Literature

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Compiled for the BLM Preservation Board by

Kirk Halford
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2001

NCS Data Base

Fire Effects Bibliography

From DOI/BLM/NCS
Contact Barbara Campbell: 303-236-6488

12/14/2000 Kirk Halford
Search of BLM library catalog for: **FIRE EFFECTS and ARCHAEOLOGY**
2 titles:
Author : Lent, Stephen C.
Author : Gaunt, Joan K.
Author : Willmer, Adisa J.
Author : Museum of New Mexico. Office of Archaeological Studies.
Author : U. S. Forest Service.
Author : Rocky Mountain Forest and Range Experiment Station (Fort Collins, Colo.)
Title : **Fire effects on archaeological resources, Phase I : the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico**
Call number : USFS G T R R M-273
Publisher : Fort Collins, Colo. : Rocky Mountain Forest and Range Experiment Station
Collation : ii, 103 p. : ill., maps ; 28 c
Series : General technical report RM ; 273
Subject : ARCHAEOLOGY--EFFECT OF FIRE ON.
Subject : ARCHAEOLOGY--NEW MEXICO.
Subject : INDIANS OF NORTH AMERICA--NEW MEXICO--ANTIQUITIES.
Subject : NEW MEXICO--ANTIQUITIES.
Subject : CULTURAL PROPERTY--PROTECTION--NEW MEXICO.
Added entry : General technical report RM ;
Notes : March, 1996. Includes bibliographical references.

Author : Lent, Stephen C.
Author : Gaunt, Joan K.
Author : Willmer, Adisa J.
Author : Maxwell, Timothy D.
Author : Museum of New Mexico. Office of Archaeological Studies.
Author : U. S. Forest Service.
Author : U. S. Bureau of Land Management.
Title : **A Study of the effects of fire on archaeological resources, Phase I : the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico**
Call number : E 78 .N65 L466 1992
Publisher : Santa Fe, N.M. : Museum of New Mexico, Office of Archaeological Studies

Collation : viii, 159 p. : ill., maps ; 28

#1518718525

ID; 88078986

CC
175
.F57
2001

930, 910, 912, 950, 957,COS&FOS
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240

July 26, 2001

In Reply Refer To:
8100 (240)P

EMS TRANSMISSION 07/30/2001
Information Bulletin No. 2001-131

To: All Field Officials
Attn: Cultural Program Leads
Fire Management Specialist

From: Group Manager, Cultural Heritage, Fossil Resources & Tribal Coordination

Subject: Bibliographic Sources Regarding the Effects of Fire on Cultural Properties.

The attached bibliography, "Fire Effects on Cultural Resources: A Bibliographic Survey of Specific and Related Literature" was compiled by Kirk Halford of the Bishop Field Office for the Bureau of Land Management (BLM) Preservation Board. The bibliography is not exhaustive, but represents an excellent starting point for anyone investigating the subject. We are grateful to Kirk for his willingness to take on this task. The diversity of topics addressed among the references of the bibliography is extensive; ranging from the effects of fire on the radiocarbon dating of the Shroud of Turin (Long 1998), to experiments in the replication of fire-cracked rock (House and Smith, 1975), to a model for assessing and treating sites using fire rehabilitation funds (Sydoriak, et.al.1998).

This is a compilation of references. It is divided into five sections, based on their source. Some are annotated, and many are not. The sections are organized in no particular order, and there may be some duplication between sections. The "Fire Management Section" contains an article by Paul Nickens entitled "The Destruction of Archaeological Sites" that is worthwhile reading for a broad perspective about sources of archaeological site destruction, and includes bibliographic references worth looking over. Particularly useful bibliographic references are provided at the final section entitled, "Western Archaeological & Conservation Center Draft Bibliography of Fire Effects on Cultural Resources."

The literature indicates that there are no simple answers to questions about how fire affects cultural resources, or how cultural resources should be considered and managed under the National Fire Program. Many variables must be accounted for in any effort to anticipate the effects of any particular fire on any particular cultural resource. For example, anticipating the effects of fire on a cultural deposit may require that the sediments in which it occurs be assessed for moisture, chemistry and composition. Evidently, moist, compact, small-grained soils low in organic content transfer less heat below the surface than dry, loose, organic, coarse soils.

DE: absolute-age; accuracy-; archaeology-; atmosphere-; C-14; carbohydrates-; carbon-; carbon-dioxide; cellulose-; cotton-; experimental-studies; heating-; isotopes-; laboratory-studies; organic-compounds; polysaccharides-; radioactive-isotopes
CC: 03-Geochronology
DT: Serial; Conference-Document
BL: Analytic
IL: Refs: 3; 1 table.
RF: GeoRef, Copyright 1999, American Geological Institute.
IS: 0033-8222
CO: RACAAT
AN: 1999-044436
UD: 199916

Record 2 of 11 - GeoRef Disc 5: 1997-1999/10

TI: Ecosystems archaeology in comparative morphostratigraphic studies of multicomponent archaeological sites on sand deposits in central Saskatchewan.
AU: Ponomarenko-Elena-V
AF: Archaeological Survey of Canada, Canadian Museum of Civilization, Hull, PQ, Canada
BK: In: Geological Society of America, 1998 annual meeting.
BA: Anonymous
SO: Abstracts with Programs - Geological Society of America. 30; 7, Pages 217. 1998.
PB: Geological Society of America (GSA). Boulder, CO, United States. 1998.
CP: United-States
PY: 1998
CN: Geological Society of America, 1998 annual meeting. Toronto, ON, Canada. Oct. 26-29, 1998.
LA: English
AB: In prairie ecosystems on sand sediments, natural disturbances such as fires, grazing and droughts easily cause mobilization and lateral migration of the substratum. The sets formed include buried soil components and the deposits separating them. The number and thickness of the layers have a high spatial heterogeneity. The soil components are either organogens, such as sod or pyrogenic layers, which accumulated on the former surface, or the results of local embedding into the substratum by pedoturbation. A standard "horizon" approach is not applicable either for genetic analysis of these formations or for revealing the isochronal formations in different loci. The "Ecosystems Archaeology" method was applied to archaeological sites to reveal diagnostic morphological features (morphons), which correspond with particular ecosystem parameters such as species of fossorial fauna, type of vegetation, types and seasonality of fires, and impact of ungulates. Radiocarbon dates of processed bones from occupation layers were used to reveal isochronal formations in different sites. These two approaches combined made it possible to identify causes and frequency of material mobilization. They showed that the most significant single sand depositions (particularly dune shifts) were caused by the impact of ungulates.

They were asynchroneous for different locations. Single episodes of fire-caused sand mobilization were asynchroneous in different sites but sets of fire-caused layers showed an increase in fire frequency and decrease in a quantity of mobilized material starting from 2000-2500 yr BP. This, in combination with an increase in humidity in this period shown by paleolimnologic data, supports anthropogenic origination of the fires. Drought-driven eolian sedimentation from lake shores was most obvious on watersheds. The morphology showed two periods of intense accumulation, divided by a period of stabilization about 5000 BP. In layers older than 4500-4000 BP, there was no contemporaneous evidence of fossorial rodents. The appearance of abundant traces of fossorial rodents on the watersheds corresponded to the end of the second long-term drought. These examples show that ecosystems archaeology can extend paleoecological reconstructions based on limnological approach.

DE: absolute-age; archaeological-sites; archaeology-; bones-; C-14; Canada-; carbon-; Cenozoic-; central-Saskatchewan; clastic-sediments; climate-change; composition-; ecosystems-; fires-; Holocene-; isotopes-; paleoecology-; paleoenvironment-; Quaternary-; radioactive-isotopes; reconstruction-; sand-; Saskatchewan-; sediments-; soils-; spatial-variations; Western-Canada
CC: 24-Quaternary-geology
DT: Abstract; Serial; Conference-Document
BL: Analytic
RF: GeoRef, Copyright 1999, American Geological Institute. Reference includes data supplied by the Geological Society of America, Boulder, CO, United States
IS: 0016-7592
CO: GAAPBC
AN: 1999-039582
UD: 199914

Record 4 of 11 - GeoRef Disc 1: 1785-1974

TI: Man the destroyer; late Quaternary changes in the Australian marsupial fauna.
AU: Merrilees-D
SO: Journal of the Royal Society of Western Australia. 51, Part 1; Pages 1-24. 1968.
PB: Royal Society of Western Australia. Perth, West. Aust., Australia. 1968.
CP: Australia
PY: 1968
LA: English
AB: Hypotheses regarding the cause of late Quaternary extinction of marsupials in Australia are examined. It is postulated that extensive use of fire by early man could have had a marked effect on ecosystems, and thereby might have been the major factor contributory to the extinction of many species of large marsupials, rather than extreme aridity. Correlations are made between the advent of man and mass extinction in Australia and elsewhere in the world. Fossil assemblages and artifacts at Billabalong, Wonberna, Guralia, and Devil's Lair in Western Australia are cited as evidence of the early association of man and now extinct marsupials.

However, since present data are inconclusive, further study of archaeology, geomorphology, and carbon-14 dates is recommended. A comprehensive bibliography is included.
DE: Australasia-; Australia-; Cenozoic-; Chordata-; evolution-; extinction-; Mammalia-; Marsupials-; paleontology-; Quaternary-; regional-; Tetrapoda-; Vertebrata-
CC: 11-Vertebrate-paleontology
DT: Serial
BL: Analytic
IL: illus. incl. sketch map.
RF: GeoRef, Copyright 1998, American Geological Institute. Reference includes data from Bibliography and Index of Geology Exclusive of North America, Geological Society of America, Boulder, CO, United States
IS: 0035-922X
CO: JRSUAU
AN: 68-11373
UD: 1968

Record 5 of 11 - GeoRef Disc 3: 1985-1992

TI: Evidence from the Swartkrans cave for the earliest use of fire.
AU: Brain-C-K; Sillen-A
AF: Transvaal Mus., Pretoria, South Africa
SO: Nature (London). 336; 6198, Pages 464-466. 1988.
PB: Macmillan Journals. London, United Kingdom. 1988.
CP: United-Kingdom
PY: 1988
LA: English
DE: Africa-; archaeological-sites; archaeology-; bones-; burnt-bones; caves-; Cenozoic-; Chordata-; Eutheria-; fire-; Hominidae-; Mammalia-; Orange-Free-State-South-Africa; paleoecology-; Pleistocene-; Primates-; Quaternary-; South-Africa; Southern-Africa; stratigraphy-; Swartkrans-; Tetrapoda-; Theria-; thermal-effects; Vertebrata-
CC: 24-Quaternary-geology
DT: Serial
BL: Analytic
IL: Refs: 7; illus. incl. 1 table, sketch maps.
RF: GeoRef, Copyright 1998, American Geological Institute.
IS: 0028-0836
CO: NATUAS
AN: 89-07450
UD: 1989

Record 7 of 11 - GeoRef Disc 4: 1993-1996

TI: Biogeochemical record of ancient man.
AU: Fogel-Marilyn-L

AF: Carnegie Institution of Washington, Geophysical Laboratory, Washington, DC, United States
BK: In: Geological Society of America, 28th annual meeting.
BA: Anonymous
SO: Abstracts with Programs - Geological Society of America. 28; 7, Pages 22. 1996.
PB: Geological Society of America (GSA). Boulder, CO, United States. 1996.
CP: United-States
PY: 1996
CN: Geological Society of America, 28th annual meeting. Denver, CO, United States. Oct. 28-31, 1996.
LA: English
AB: Humans, omnivorous animals capable of thought, can consciously influence their own physiological state and thereby affect to some extent the biochemical and isotopic contents of their bodies. In addition, because man has developed various levels of technology, e.g., the use of fire, he has been able to sway regional and possibly global climate. Paleodietary studies of humans are important, as hunting and gathering, horticulture, or pastoralism were primary pursuits for much of man's history. Stable isotopic records from archaeological skeletal remains provide the material for study and interpretation, when written or other archaeological records do not exist. For example, on Easter Island, a thriving culture once existed 1-2 kA ago, but owing to starvation and possible cannibalism, the society withered to its current present levels. Were these people able to take advantage of the rich marine food sources of their island? Or did they never develop the necessary boating and fishing technology? Examples of the spread of important food sources into the Americas, the duration of nursing of infants and the timing of weaning, and the movement of people between continents will be explained with geochemical data. A challenge still exists to find a long-term record of human influence on regional or continental climate. The persistent use of fire by early Aborigines in Australia may have resulted in altered vegetation and a decreased ability of the ecosystem to retain water in plants and soils, thus effecting climate change. Isotopic evidence for the past 50 kA from the Lake Eyre Basin, Central Australia, will be presented.
DE: archaeology-; Australasia-; Australia-; biochemistry-; Cenozoic-; changes-; climate-; ecosystems-; geochemistry-; Holocene-; isotopes-; Lake-Eyre-Basin; Plantae-; Quaternary-; soils-; South-Australia; stable-isotopes
CC: 24-Quaternary-geology
DT: Abstract; Serial; Conference-Document
BL: Analytic
RF: GeoRef, Copyright 1998, American Geological Institute. Reference includes data supplied by the Geological Society of America, Boulder, CO, United States
IS: 0016-7592
CO: GAAPBC
AN: 97-40244
UD: 199714

Record 8 of 11 - GeoRef Disc 4: 1993-1996

TI: Fracture and burn patterns of fire altered rock.
AU: Athan-Heidi-K
AF: University of Nebraska, Department of Anthropology, Lincoln, NE, United States
BK: In: Proceedings of the Nebraska Academy of Sciences; 1880-1995, including the NATS & TER-QUA divisions and affiliated societies; one hundred-fifth annual meeting.
BA: Zechmann-Albert (chairperson)
SO: Proceedings of the Nebraska Academy of Sciences and Affiliated Societies. 105; Pages 6. 1995.
PB: Nebraska Academy of Sciences. Lincoln, NE, United States. 1995.
CP: United-States
PY: 1995
CN: Proceedings or the Nebraska Academy of Sciences; one hundred-fifth annual meeting. Lincoln, NE, United States. April 28-29, 1995.
LA: English
DE: archaeology-; detection-; effects-; erosion-; experimental-studies; fires-; fractures-; hearths-; middens-; moisture-; Nebraska-; Oglala-National-Grassland; patterns-; rocks-; thermal-alteration; United-States
CC: 24-Quaternary-geology
DT: Abstract; Serial; Conference-Document
BL: Analytic
RF: GeoRef, Copyright 1998, American Geological Institute.
IS: 0077-6343
CO: PNBAAP
AN: 95-44220
UD: 199516

Record 9 of 11 - GeoRef Disc 4: 1993-1996

BK: Quaternary paleoclimate variation as evidenced by Paleosols; implications for anthropogenic impact on landscape instability around an Anasazi site in Kane County, Utah.
BA: Kulp-Thomas-R
CP: United-States
PY: 1995
DG: Master's
DI: East Carolina University. Greenville, NC, United States. Pages: 199.
LA: English
AB: Geochemical and classic geological techniques used to interpret the pedogenesis of floodplain soils formed between AD 100 and the present suggest anthropogenic causes for landscape instability in southern Utah. Previous workers have suggested that the Anasazi civilization that inhabited the study area abandoned it around AD 1150 because of changes in regional precipitation patterns. Floodplain paleosols, however, do not show evidence for significant long term climatic variability. The Quaternary stratigraphy of the study area is represented by three major sedimentary sequences that date to the Pleistocene and Holocene and are characterized by multiple episodes of alluvial erosion and sedimentation. Paleosols in these

alluvial strata represent periods of active pedogenesis during times of minimal deposition. The character of the paleosols demonstrates relatively little variation in macroscopic or micro-morphologic features. The Pleistocene soils are almost exclusively Haplargids and Calciorthids and Holocene soils are characterized by Calciorthids and Entisols. The stable isotopic ratios of paleosol-carbonates indicate that C (sub 4) plants were the predominant vegetation for each soil. Rainfall estimates from the depth to soil calcic horizons suggest that rainfall may have been slightly higher at the time of maximum Anasazi habitation (around AD 1000), but paleosol data do not indicate a significant climatic change in the Quaternary. Whereas the paleosols in the fill units show little variation over time, the cut and fill events themselves tend to increase in magnitude over time. This increased erosion through time in the absence of increased rainfall, along with the abundance of charcoal in the fill units, suggests that the Anasazi were clearing the surrounding land by slash-and-burn agricultural methods. Dendroclimatic reconstructions by other workers suggest that yearly and decadal variations in paleoclimate may also have contributed to landscape instability in the area. The resulting erosion would have served to make the area less suitable for an agriculturally based civilization, and could have contributed to the Anasazi's decision to abandon the area.
DE: archaeological-sites; archaeology-; Calciorthids-; Cenozoic-; climate-; Entisols-; erosion-; Haplargids-; Holocene-; human-activity; Kane-County-Utah; landscapes-; micromorphology-; paleoclimatology-; Paleosols-; pedogenesis-; Quaternary-; soil-erosion; soils-; stability-; United-States; Utah-
CC: 24-Quaternary-geology
DT: Thesis-or-Dissertation
BL: Monograph
MC: LAT: N370000; N373200; LONG: W1104000; W1125500.
IL: Refs: 41; illus. incl. 6 tables.
RF: GeoRef, Copyright 1998, American Geological Institute.
AN: 96-65620
UD: 199620

Record 10 of 11 - GeoRef Disc 4: 1993-1996

TI: The development of high moorland on Dartmoor; fire and the influence of Mesolithic activity on vegetation change.
AU: Caseldine-Chris; Hatton-Jackie
AF: University of Exeter, Department of Geography, Exeter, United Kingdom
BK: In: Climate change and human impact on the landscape; studies in palaeoecology and environmental archaeology.
BA: Chambers-F-M (editor)
SO: Pages 119-131. 1993.
PB: Chapman and Hall. London, United Kingdom. 1993.
CP: United-Kingdom
PY: 1993
LA: English

DE: Cenozoic-; charcoal-; climate-; Dartmoor-; deforestation-; Devonshire-England; England-; Europe-; fires-; floral-studies; grazing-; Great-Britain; Holocene-; human-activity; Mesolithic-; miospores-; modern-; organic-residues; palynomorphs-; peat-; pollen-; Quaternary-; sediments-; Stone-Age; United-Kingdom; vegetation-; Western-Europe
CC: 24-Quaternary-geology
DT: Book
BL: Analytic
IL: illus. incl. sketch map.
RF: GeoRef, Copyright 1998, American Geological Institute.
IB: 0-412-46200-1
AN: 95-54125
UD: 199520

Search of AGRICOLA for keywords: **fire/burn AND archaeology/cultural resources**
123 citations

Record 1 of 123 - AGRICOLA 1998-2000/09

AN: IND 22053434
UD: 200009
AU: Hornberg,-G.; Ostlund,-L.; Zackrisson,-O.; Bergman,-I.
TI: The genesis of two Picea-Cladina forests in northern Sweden.
SO: J-ecol. Oxford : Blackwell Science Ltd. Oct 1999. v. 87 (5) p. 800-814.
CN: DNAL 450-J829
PA: Foreign
PY: 1999
LA: English
CP: England; UK
CO: JECOAB
IS: ISSN: 0022-0477
NT: Includes references.
PT: Article
SF: IND
DE: forests-. stand-development. cladonia-. picea-. vegetation-. plant-communities. disturbed-land. history-. paleoecology-. pollen-analysis. charcoal-. dendroclimatology-. maps-. climatic-factors. grazing-. logging-. shrubs-. sweden-.
CC: F300; K001
AB: 1. In northern Fennoscandia a rare forest type, characterized by Cladina species and Picea abies, occurs on dry productive sites outside the range of permafrost but close to the Scandes mountains. 2. We determined the history of vegetation development and disturbance of two Picea-Cladina forests to test the hypothesis that this forest type has a natural origin. 3. We used a combination of several retrospective vegetation history and archaeological methods, i.e. the analysis of pollen, macroscopic charcoal, dendroecological data, written historical sources, maps

and ancient remains. 4. The results suggest that the Picea-Cladina forests investigated are not the products of purely natural factors. 5. Under the influence of harsh climatic conditions and anthropogenic impact, mainly by repeated fires, grazing, trampling and probably also selective cutting of Pinus, mixed coniferous forests, dominated by feather mosses and dwarf shrubs, may have evolved into the Picea-Cladina type. 6. Repeated anthropogenic use of fire, already established c. 2000 years ago, may have been used to create lichen-dominated areas, initially to attract game but later to improve winter grazing resources for reindeer. This finding contradicts the general view that Saami nomads did not use fire to alter forest vegetation.
XAU: Swedish University, Umea.

Record 2 of 123 - AGRICOLA 1998-2000/09

AN: IND 21971943
UD: 199903
AU: Bowman,-D.M.J.S.
TI: Tansley Review No. 101. The impact of Aboriginal landscape burning on the Australian biota.
SO: New-phytol. Cambridge : Cambridge University Press. Nov 1998. v. 140 (3) p. 385-410.
CN: DNAL 450-N42
PA: Foreign
PY: 1998
LA: English
CP: England; UK
CO: NEPHAV
IS: ISSN: 0028-646X
NT: Includes references.
PT: Article
SF: IND
DE: wildfires-. palynology-. aborigines-. landscape-. burning-. history-. ecosystems-. habitats-. paleoecology-. archaeology-. fauna-. extinction-. geomorphology-. environmental-impact. nature-conservation. biodiversity-. vegetation-. plant-communities. erosion-. literature-reviews. fire-ecology. fire-effects. plant-colonization. australia-.
CC: F300
XAU: Northern Territory University, Australia.

Record 3 of 123 - AGRICOLA 1998-2000/09

AN: IND 21379658
UD: 9809
AU: Ogden,-J.; Basher,-L.; McGlone,-M.
TI: Fire, forest regeneration and links with early human habitation: evidence from New Zealand.
SO: Ann-bot. London ; New York : Academic Press,. June 1998. v. 81 (6) p. 687-696.
CN: DNAL 450-An7
PA: Foreign

PY: 1998
LA: English
CP: England; UK
CO: ANBOA4
IS: ISSN: 0305-7364
NT: Includes references.
PT: Article
SF: IND
DE: forest-fires. natural-regeneration. archaeology-. species-diversity. stand-characteristics. radiocarbon-dating. plant-succession. adaptation-. palynology-. climate-. history-. drought-. literature-reviews. paleoecology-. forest-ecology. new-zealand.
CC: F300; K001
AB: New Zealand forests burn less frequently than tussock grasslands, heath or shrublands. Species composition, past disturbance and stand condition determine inflammability and fuel load, and consequent fire intensity and spatial extent. Before people arrived, fires were ignited by lightning during drought years on the eastern sides of both islands. Volcanism occurring every 300-600 years was associated with fires in the central North Island. A review of radiocarbon-dated charcoal from the eastern South Island, and of evidence for fire in pollen profiles from the North Island, provide the basis for an assessment of fire frequency. Forest fires have occurred on both New Zealand's islands throughout the Holocene at least every few centuries, until the last millennium when frequency increased. The 'return time' of fire at any one place in the forested landscape was probably one or two millennia. Burned areas usually succeeded to forest again before the next inflagration. Consequently fire adaptation is infrequent in the New Zealand flora, and Polynesian forest clearance was rapid and largely permanent. There is an indication of an increase in fire frequency in the late Holocene, and a clear signal associated with people approx. 700 years BP. Separating the earliest anthropogenic fires from the background level of natural burning will be difficult without additional evidence.

Record 4 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236906
UD: 9807
AU: Lentz,-S.C.
TI: Phase II research design.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 90-97.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.

PT: Article
SF: IND
DE: archaeological-material. fire-effects. research-. experimental-design. prescribed-burning. fuel-appraisals. temperature-. guidelines-. land-management. historic-buildings. historic-sites. archaeology-. structures-. artefacts-. ceramics-. stones-. rocks-. dendrochronology-. age-determination. hydration-. new-mexico.
ID: fire-intensity. sooting-.
CC: K810; X800

Record 5 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236905
UD: 9807
AU: Lentz,-S.C.
TI: Phase I conclusions.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 84-89.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: artefacts-. historic-buildings. fire-effects. archaeology-. archaeological-material. historic-sites. damage-. forest-fires. age-determination. tuff-. building-materials. subsurface-layers. fuel-appraisals. ceramics-. stones-. rocks-. management-. fire-control. new-mexico.
ID: fire-intensity. sooting-. spalling-.
CC: X800; K810

Record 6 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236904
UD: 9807
AU: Origer,-T.
TI: Obsidian hydration.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 81-83.

CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: artefacts-. stones-. rocks-. hydration-. fire-effects. archaeology-. archaeological-material. historic-sites. historic-buildings. damage-. forest-fires. new-mexico.
CC: X800; K810

Record 7 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236903
UD: 9807
AU: Willmer,-A.
TI: Architectural materials.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 74-80.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: structures-. building-materials. fire-effects. archaeology-. archaeological-material. historic-sites. historic-buildings. damage-. forest-fires. tuff-. oxidation-. reduction-. erosion-. new-mexico.
ID: spalling-.
CC: X800; K810

Record 8 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236902
UD: 9807
AU: Lentz,-S.C.
TI: Lithic artifact analysis.
ST: General technical report RM ; 273.

SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 65-73.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: artefacts-. stones-. fire-effects. archaeology-. archaeological-material. historic-sites. damage-. forest-fires. spatial-distribution. oxidation-. history-. subsurface-layers. shape-. materials-. surface-area. reduction-. new-mexico.
ID: fire-intensity. sooting-. potlids-. crazing-.
CC: X800; K810

Record 9 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236901
UD: 9807
AU: Lentz,-S.C.
TI: Ground-stone artifact analysis.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 61-64.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: artefacts-. stones-. fire-effects. archaeology-. archaeological-material. historic-sites. damage-. forest-fires. spatial-distribution. oxidation-. history-. new-mexico.
ID: fire-intensity. sooting-. spalling-.
CC: X800; K810

Record 10 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236900
UD: 9807

AU: Gaunt,-J.K.; Lentz,-S.C.
TI: Ceramic artifact analysis.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 47-60.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: artefacts-. ceramics-. fire-effects. archaeology-. archaeological-material. historic-sites. damage-. forest-fires. spatial-distribution. oxidation-. history-. subsurface-layers. new-mexico.
ID: fire-intensity. sooting-. spalling-.
CC: X800; K810

Record 11 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236899
UD: 9807
AU: Gaunt,-J.K.; Lentz,-S.C.; Willmer,-A.J.
TI: Site descriptions.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 24-46.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: archaeology-. archaeological-material. historic-sites. historic-buildings. site-factors. artefacts-. ceramics-. age-determination. masonry-. structures-. new-mexico.
CC: X800

Record 12 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236898

UD: 9807
AU: Lentz,-S.C.
TI: Phase I archaeological field work and methods.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 20-23.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: archaeology-. archaeological-material. field-experimentation. historic-sites. historic-buildings. temperature-. length-. damage-. site-factors. artefacts-. prediction-. age-determination. methodology-. fire-effects. forest-fires. wildfires-. new-mexico.
ID: fire-intensity.
CC: X800; K810

Record 13 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236897
UD: 9807
AU: Lentz,-S.C.
TI: Cultural historical background.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 14-19.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: history-. historic-sites. archaeology-. archaeological-material. american-indians. new-mexico.
CC: X800

Record 14 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236896
UD: 9807
AU: Lentz,-S.C.; Gaunt,-J.K.; Willmer,-A.J.
TI: Physical environment.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 12-13.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: geology-. forest-fires. site-factors. hydrology-. water-availability. soil-. silt-loam-soils. sandy-loam-soils. alluvial-soils. soil-properties. vegetation-. canopy-. understory-. mountain-forests. environmental-temperature. diurnal-variation. seasonal-variation. rain-. mountain-areas. fauna-. new-mexico.
CC: F300; K001; B200; J200

Record 15 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236895
UD: 9807
AU: Cartledge,-T.
TI: Previous research in the Holiday Mesa, area.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 10-11.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: archaeological-material. archaeology-. historic-sites. surveys-. inventories-. fire-effects. forest-fires. new-mexico.
CC: X800; K810

Record 16 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236894
UD: 9807
AU: Cartledge,-T.
TI: Previous fire effect studies.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 9.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: fire-effects. research-. wildfires-. prescribed-burning. damage-. archaeological-material. archaeology-. monitoring-. historic-sites. soil-.
CC: K810; X800

Record 17 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236893
UD: 9807
AU: Buchanan,-L.; Moody,-R.; Neff,-P.; Cartledge,-T.
TI: Behavior of the Henry Fire in the Jemez Mountains.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 4-8.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND
DE: wildfires-. fire-control. fire-fighting. dendrochronology-. forest-fires. seasonal-variation. frequency-. grazing-. fuel-appraisals. fire-effects. damage-. fire-behavior. new-mexico.
CC: K810

Record 18 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236892
UD: 9807
AU: Cartledge,-T.
TI: Research orientation.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 3.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: includes references.
PT: Article
SF: IND
DE: wildfires-. archaeological-material. archaeology-. fire-control. artefacts-. monitoring-. forest-fires. historic-sites. prescribed-burning. temperature-. fire-effects. age-determination. new-mexico.
CC: K810; X800

Record 19 of 123 - AGRICOLA 1998-2000/09

AN: IND 21236891
UD: 9807
AU: Lentz,-S.C.
TI: Fire effects on archaeological resources. Phase 1. The Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico.
ST: General technical report RM ; 273.
SO: Fire effects on archaeological resources, phase I the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico /. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996]. p. 1-2.
CN: DNAL aSD11.A42-no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: Includes references.
PT: Article
SF: IND

DE: prescribed-burning. wildfires-. archaeological-material. archaeology-. fire-control. management-. artefacts-. forest-fires. forest-management. new-mexico.
ID: fire-management.
CC: K810; X800

Record 20 of 123 - AGRICOLA 1998-2000/09

AN: CAT 10877113
UD: 199911
CA: National Fire Protection Association.
TI: NFPA 909, standard for the protection of cultural resources including museums, libraries, places of worship, and historic properties. 1997 ed.
OT: Standard for the protection of cultural resources including museums, libraries, places of worship, and historic properties.
SO: Quincy, MA : National Fire Protection Association, c1997. 226 p. : ill.
CN: DNAL TH9445.M8-N3-1997
PA: Other-US
PY: 1997
LA: English
CP: Massachusetts; USA
NT: Includes bibliographical references and index.
PT: Monograph; Bibliography
DE: Museums-Fires-and-fire-prevention-Standards-United-States. Libraries-Fires-and-fire-prevention-Standards-United-States. Fire-prevention-Standards-United-States.
CC: X200; X600
Record 109 of 123 - AGRICOLA 1992-1997

AN: IND 20535966
UD: 9611
AU: Clark,-J.S.; Royal,-P.D.
TI: Local and regional sediment charcoal evidence for fire regimes in presettlement north-eastern North America.
SO: J-ecol. Oxford : Blackwell Science Ltd. 1996. v. 84 (3) p. 365-382.
CN: DNAL 450-J829
PA: Foreign
PY: 1996
LA: English
CP: England; UK
CO: JECOAB
IS: ISSN: 0022-0477
NT: Includes references.
PT: Article
SF: IND

DE: mixed-forests. fire-ecology. fire-effects. lakes-. pollen-. sediment-. wood-. history-. burning-. pollen-analysis. archaeology-. paleoecology-. forest-ecology. deciduous-forests. minnesota-. ontario-. new-york. maine-. wisconsin-. pennsylvania-.
ID: burned-wood. fire-history.
CC: F300; K001; K810
AB: Presettlement fire regimes in north-eastern North America and their dependence on climate, fuels, and cultural patterns are poorly understood due to lack of relevant historic or palaeoecological data. Annual records of sediment charcoal accumulation were compiled from seven sites spanning the last 2000 years and representing important climate, vegetation, and cultural settings. Results were compared across sites and across changes in Indian cultures to determine whether fire patterns might be explained by one or more of these variables. Clearly interpretable fires were restricted to the western (most xeric) portion of our study region in Pine Hardwoods of Minnesota, a single fire in Northern Hardwoods of northern Wisconsin, and cultural burning near an Iroquois village in southern Ontario. Other sites in Northern Hardwoods and Hardwood-Hemlock forests did not show clear evidence of fire. Spectral analysis suggested instances in which local fire regimes departed from regional ones. Our interpretation suggests substantially longer intervals between fires than reported in previous sediment charcoal studies. We did not find evidence for fire in mixed oak forests, where it has been speculated that fire might be necessary for oak recruitment, suggesting need for further analysis. A single site in northern Wisconsin was the only Algonquin site showing a clear increase in charcoal suggesting local fire. Algonquin use of fire for hunting may not have affected our sites. A single site in Sioux territory experienced such frequent fire that cultural effects were not evident, even when Sioux were replaced by Chippewa (Algonquin) in the 18th century. One of two Iroquois sites showed clear increases in charcoal during.
occupation. The second site may not have had settlements nearby.
XAU: Duke Univerity, Durham, NC.

Record 110 of 123 - AGRICOLA 1992-1997

AN: IND 20523632
UD: 9609
AU: Kirch,-P.V.
TI: Late Holocene human-induced modifications to a central Polynesian island ecosystem.
SO: Proc-Natl-Acad-Sci-U-S-A. Washington, D.C. : National Academy of Sciences,. May 28, 1996. v. 93 (11) p. 5296-5300.
CN: DNAL 500-N21P
PA: Other-US
PY: 1996
LA: English
CP: District-of-Columbia; USA
CO: PNASA6
IS: ISSN: 0027-8424
NT: Includes references.
PT: Article

SF: IND
DE: vegetation-. paleobotany-. paleoecology-. palynology-. pollen-. environmental-impact. man-. colonization-. islands-. biogeography-. water-erosion. fires-. plant-ecology. fire-ecology. land-use. archaeology-. deforestation-. forest-trees. botanical-composition. cook-islands.
ID: mangaia-island. human-impact.
CC: F300; K001; J800; K800
AB: A 7000-year-long sequence of environmental change during the Holocene has been reconstructed for a central Pacific island (Mangaia, Cook Islands). The research design used geomorphological and palynological methods to reconstruct vegetation history, fire regime, and erosion and depositional rates, whereas archaeological methods were used to determine prehistoric Polynesian land use and resource exploitation. Certain mid-Holocene environmental changes are putatively linked with natural phenomena such as eustatic sea-level rise and periodic El Nino-Southern Oscillation events. However, the most significant changes were initiated between 2500 and 1800 years and were directly or indirectly associated with colonization by seafaring Polynesian peoples. These human-induced effects included major forest clearance, increased erosion of volcanic hillsides and alluvial deposition in valley bottoms, significant increases in charcoal influx, extinctions of endemic terrestrial species, and the introduction of exotic species.
XAU: University of California, Berkeley, CA.

Record 111 of 123 - AGRICOLA 1992-1997

AN: CAT 10751071
UD: 9608
AU: Lentz,-Stephen-C.
CA: Rocky Mountain Forest and Range Experiment Station (Fort Collins, Colo.).
TI: Fire effects on archaeological resources, phase I : the Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico.
OT: Henry Fire, Holiday Mesa, Jemez Mountains, New Mexico.
ST: General technical report RM ; 273.
SO: Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, [1996] ii, 103 p. : ill., maps
CN: DNAL aSD11.A42--no.273
PA: USDA
PY: 1996
LA: English
CP: Colorado; USA
NT: "March, 1996."
Includes bibliographical references (p. 98-103).
PT: Monograph; Bibliography
DE: Cultural-property,-Protection-of-New-Mexico-Jemez-Mountains. Wildfires-New-Mexico-Jemez-Mountains. Prescribed-burning-New-Mexico-Jemez-Mountains. Archaeology-New-Mexico-Jemez-Mountains.
CC: K110; X800

Record 112 of 123 - AGRICOLA 1992-1997

AN: IND 20428136
UD: 9411
AU: Lewis,-H.T.
TI: Management fires vs. corrective fires in northern Australia: an analogue for environmental change.
SO: Chemosphere. Oxford : Pergamon Press. Sept 1994. v. 29 (5) p. 949-963.
CN: DNAL TD172.C54
PA: Foreign
PY: 1994
LA: English
CP: England; UK
CO: CMSHAF
IS: ISSN: 0045-6535
NT: In the special issue: Preindustrial human environmental impacts: Are there lessons for global change science and policy? / edited by D.M. Kammer, K.R. Smith, A.T. Rambo, and M.A.K. Khalil.
Proceedings of a conference held September 17-19, 1993, Honolulu, Hawaii.
Includes references.
PT: Article
SF: IND
DE: vegetation-management. grasslands-. forests-. fire-effects. dry-season. ethnic-groups. archaeology-. northern-territory.
ID: monsoon-forests. aborigines-.
CC: W000; P000; K800; X800

Record 114 of 123 - AGRICOLA 1992-1997

AN: CAT 93989659
UD: 9303
AU: Scott,-Douglas-D.
TI: Don't burn that wickiup! : some considerations of cultural resources in fire management.
OT: Some considerations of cultural resources in fire management.
SO: [S.l. : Fire Operations, Montrose District, Bureau of Land Management?, 1978] 7, [3] leaves
CN: DNAL SD421.32.A165S35-1978
PA: Other-US
PY: 1978
LA: English
CP: No-place-unknown-or-undetermined
NT: Cover title.

"Prepared for Fire Operations, Montrose District, Bureau of Land Management."
"October, 1978."
Includes bibliographical references (leaves [8-10]).
PT: Monograph; Bibliography
DE: Forest-fires-Southwestern-States-Prevention-and-control.
CC: K810

Record 115 of 123 - AGRICOLA 1992-1997

AN: IND 92057099
UD: 9210
AU: Swan,-L.; Francis,-C.
TI: Fire and archaeology.
SO: Fire-Manage-Notes-U-S-Dep-Agric-For-Serv. Washington, D.C. : The Service. 1991. v. 52 (1) p. 21.
CN: DNAL 1-F766FI
PA: USDA
PY: 1991
LA: English
IS: ISSN: 0194-214X
PT: Article
DE: fire-control. forest-fires. fire-suppression. archaeological-material. ancient-monuments.
CC: K810; P300
XAU: USDA Forest Service, Shaver Lake, CA.

Record 116 of 123 - AGRICOLA 1992-1997

AN: IND 92016696
UD: 9204
AU: Fosberg,-S.; Gallagher,-J.; Lincoln,-T.; Spoerl,-P.; Wilson,-K.
TI: Research agenda for management impacts on cultural resources.
SO: Gen-Tech-Rep-RM-Rocky-Mt-For-Range-Exp-Stn-U-S-Dep-Agric-For-Serv. Fort Collins, Colo. : The Station. 1988. (164) p. 26-31.
CN: DNAL aSD11.A42
PA: USDA
PY: 1988
LA: English
IS: ISSN: 0277-5786
NT: In the series analytic: Tools to manage the past: research priorities for cultural resources management in the southwest: symposium proceedings, May 2-6, 1988, Grand Canyon, Arizona / edited by J.A. Tainter and R.H. Hamre.
Includes references.
PT: Article

DE: forest-management. cultural-heritage. research-. range-management. fire-prevention. preservation-. usa-.
CC: K200; X800
XAU: Bureau of Land Management, New Mexico State Office, Santa Fe, NM.

Record 118 of 123 - AGRICOLA (1984 - 12/91)

AN: IND 91030249
UD: 9109
AU: Swan,-L.; Francis,-C.
TI: Fire and Archaeology.
SO: Gen-Tech-Rep-PSW-U-S-Dep-Agric-For-Serv-Pac-Southwest-For-Range-Exp-Stn. Berkeley, Calif. : The Station. Mar 1989. (109) p. 156.
CN: DNAL aSD11.A325
PA: USDA
PY: 1989
LA: English
CO: XFGTB
IS: ISSN: 0092-9662
PT: Article
DE: archaeology-. fire-prevention. california-.
CC: K810
XAU: Sierra National Forest, CA.

Record 119 of 123 - AGRICOLA (1984 - 12/91)

AN: IND 91015750
UD: 9105
AU: Lissoway,-J.; Propper,-J.
TI: Effects of fire on cultural resources.
SO: Gen-Tech-Rep-RM-Rocky-Mt-For-Range-Exp-Stn-U-S-Dep-Agric-For-Serv. Fort Collins, Colo. : The Station. May 1990. (191) p. 25-30. ill.
CN: DNAL aSD11.A42
PA: USDA
PY: 1990
LA: English
IS: ISSN: 0277-5786
NT: Paper presented at a symposium on "Effects of Fire Management of Southwestern Natural Resources," Nov 15-17, 1988, Tucson, Arizona.
Includes references.
PT: Article
DE: forest-fires. fire-effects. fire-suppression. cultural-heritage. heritage-areas.
CC: K810; X800
XAU: Natural and Cultural Resources Management of Bandelier National Monument, Mexico.

Record 121 of 123 - AGRICOLA (1984 - 12/91)

AN: IND 88022264
UD: 8809
AU: Hunter,-J.E.
TI: Prescribed burning for cultural resources.
SO: Fire-Manage-Notes-U-S-D-A-For-Serv. Washington, D.C. : The Service. 1988. v. 49 (2) p. 8-9.
CN: DNAL 1-F766FI
PA: USDA
PY: 1988
LA: English
IS: ISSN: 0194-214X
NT: Includes references.
PT: Article
DE: forest-fires. prescribed-burning. corylus-cornuta. prescribed-burning.
ID: xerophyllum-tenax.
CC: K810; K110; K590

Record 122 of 123 - AGRICOLA (1984 - 12/91)

AN: IND 85076384
UD: 8512
AU: Roberts,-J.E.
TI: Protection of archaeological sites and special areas during prescribed burning.
SO: Fire-Manage-Notes-U-S-D-A-For-Serv. Washington, D.C. : The Service. 1985. v. 46 (3) p. 9-10. ill.
CN: DNAL 1-F766FI
PA: USDA
PY: 1985
LA: English
PT: Article
DE: prescribed-burning. archaeological-material. protection-. fire-suppression.
CC: K810; K110

Record 123 of 123 - AGRICOLA (1984 - 12/91)

AN: IND 85025034
UD: 8506
AU: Anderson,-B.A.
TI: Archeological considerations for park and wilderness fire management planning.
SO: U-S-D-A-For-Serv-Gen-Tech-Rep-INT-Intermt-For-Range-Exp-Stn. Ogden, Utah : The Station. Apr 1985. (182) p. 145-148.

CN: DNAL aSD11.A48
PA: USDA
PY: 1985
LA: English
CO: XGTIA
IS: ISSN: 0363-6186
NT: Paper presented at the "Symposium and Workshop on Wilderness Fire," Nov. 15/18, 1983, Missoula, Montana.
Includes references.
PT: Article
DE: forest-fires. fire-control. archaeology-. parks-. wilderness-.
CC: K810

12/19/2000 Kirk Halford
Search of DIALOG databases
5 citations

Search for keywords: **fire effects and archaeology**

1.)
DIALOG(R)File 8:Ei Compendex(R)
Title: **EFFECTS OF LA MESA FIRE ON BANDELIER'S CULTURAL RESOURCES.**
Author: Traylor, Diane
Conference Title: La Mesa Fire Symposium.
Conference Location: Los Alamos, NM, USA Conference Date: 19811006
Sponsor: Los Alamos Natl Lab, Los Alamos Natl Environmental Research Park, Los Alamos, NM, USA; Natl Park Service, Southwest Region, Santa Fe, NM, USA; Southwest Fire Council, USA
E.I. Conference No.: 05036
Source: Los Alamos National Laboratory (Report) LA 9236-NERP. Publ by Los Alamos Natl Lab, Los Alamos, NM, USA. Available from NTIS, Springfield, Va, USA p 97-102
Publication Year: 1984
CODEN: LANLDK
Language: English
Document Type: PA; (Conference Paper)
Journal Announcement: 8411
Descriptors: *FORESTRY--*Fire Protection
Identifiers: FOREST FIRES; LA MESA FIRE; BANDELIER NATIONAL MONUMENT; ARCHEOLOGICAL SITES; FIRE DAMAGE TO CULTURAL RESOURCES; HEAT DAMAGE TO
ARTIFACTS; FIRE ECOLOGY
Classification Codes:

821 (Agricultural Equipment & Methods); 914 (Safety Engineering)
82 (AGRICULTURE & FOOD TECHNOLOGY); 91 (ENGINEERING MANAGEMENT)

Search for keywords: **forest fire/prescribed burn and archaeology**

2).
DIALOG(R)File 6:NTIS
NTIS Accession Number: PB91-123398
Impacts of Prescribed Burning on Archeological and Biological Resources of the Knife River Indian Villages NHS
(Final rept. 23 May 88-1 Jul 89)
Sayler, R. D. ; Seabloom, R. W. ; Ahler, S. A. ; Picha, P. R. ; Seabloom, N. R. North Dakota Univ., Grand Forks.
Corp. Source Codes: 013173000
Sponsor: National Park Service, Washington, DC.
Jul 89 134p
Languages: English
Journal Announcement: GRAI9105
Sponsored by National Park Service, Washington, DC.
Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)321-8547; and email at orders@ntis.fedworld.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
NTIS Prices: PC A07/MF A01
Country of Publication: United States

The Knife River Indian Villages National Historic Site (KNRI) was established in 1974 for the purpose of insuring the preservation, interpretation, and research of unique historical and archeological resources associated with the Plains Indian and various cultural-historic periods (Hellickson-Key 1984). The park harbors evidence of several centuries of human activity, especially post ca. 1750, and is noted for its earthlodge village sites, historical associations with Lewis and Clark and other Euro-American explorers, as well as being a site of the agricultural phase of Plains Indian development. Cultural resource studies have revealed a wealth of archeological artifacts and historical sites within the 520 ha of KNRI. The report describes results of a research program designed to experimentally test major impacts of prairie fires on archeological materials common to KNRI. We also review known impacts of burning programs on both artifacts and selected plant species common to KNRI. Based on these results, we present a series of technical management recommendations to:(1) preserve the valuable archeological resources of KNRI, (2) mitigate potentially negative impacts of prescribed burning programs, and (3) utilize safe fire management procedures to enhance the plant and animal communities of KNRI.

Descriptors: *Archaeology; *Fires; Management planning; Parks; Forecasting; Maintenance; American Indians
Identifiers: *Knife River Indian Villages National Historic Site; *Historic preservation; *Prescribed burning; Cultural resources; Ecosystems

; Plant communities; Artifacts; NTISDIPSDH
Section Headings: 92D (Behavior and Society--Education, Law, and Humanities)

3.)
DIALOG(R)File 111:TGG Natl.Newspaper Index(SM)
After a forest fire, it's the thrill of the hunt for this Forest-Service archaeologist.
(Features)(Ideas)
Christian Science Monitor, 18
Sept 14, 2000
ISSN: 0882-7729 LANGUAGE: English RECORD TYPE: Citation

Search for keywords: **prescribed burn/forest fire and cultural resources**

4.)
DIALOG(R)File 6:NTIS
NTIS Accession Number: PB81-217713/XAB
Flag Prairie Validation Prescribed Control Burn Cultural Resource Reconnaissance
(Final rept. 20-23 Oct 80)
Zilverberg, G.
Malheur National Forest, John Day, OR.
Corp. Source Codes: 072355000
Report No.: MNF/646-81/014
Jan 81 47p
Languages: English
Journal Announcement: GRAI8122
Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)321-8547; and email at orders@ntis.fedworld.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
NTIS Prices: PC A03/MF A01
Country of Publication: United States
To comply with Federal rules and regulations concerning protection of cultural resources on public land, a cultural resource reconnaissance was conducted over the Flag Prairie Range Validation Prescribed Control Burn project, an area of 250 acres, during October 1980. The project area is located in the Northern Great Basin of east-central Oregon. The reconnaissance resulted in the location and identification of one prehistoric and one isolated-find properties.
Descriptors: *Archaeology; History; Sites; Public land; Surveys; Protection; Mountains; Fossils; Environmental impacts; Subsurface investigations; Ethnology; Field tests; Oregon; Maps; Evaluation
Identifiers: *Historic preservation; *Prescribed burning; Grant County(Oregon); Malheur National Forest; Points; NTISAGFSMN

Section Headings: 92D (Behavior and Society--Education, Law, and Humanities); 48D (Natural Resources and Earth Sciences--Forestry)

5.)
DIALOG(R)File 6:NTIS
NTIS Accession Number: PB91-137448
1977 La Mesa Fire Study: An Investigation of Fire and Fire Suppression Impact on Cultural Resources in Bandelier National Monument
Traylor, D. ; Hubbell, L. ; Wood, N. ; Fiedler, B.
National Park Service, Santa Fe, NM. Southwest Cultural Resources Center.
Corp. Source Codes: 022304002
Report No.: PP-28
Jan 90 225p
Languages: English
Journal Announcement: GRAI9108
Order this product from NTIS by: phone at 1-800-553-NTIS (U.S. customers); (703)605-6000 (other countries); fax at (703)321-8547; and email at orders@ntis.fedworld.gov. NTIS is located at 5285 Port Royal Road, Springfield, VA, 22161, USA.
NTIS Prices: PC A10/MF A02
Country of Publication: United States

The La Mesa Fire occured in 1977, and the report was essentially completed two year later. With 90 percent of the editorial work completed, funding apparently ran out, the staff dispersed, and the work was put on the shelf. In 1990, the Southwest Region's Branch of Cultural Resources Management undertook the task of reviving and publishing the study in its original form. Topics covered include: A Survey of Fire-Impacted Areas in Bandelier National Monument; Excavations and Sampling of Four Sites Within the La Mesa Burn; The Impact of Fire and Fire Suppression On Cultural Resources in Bandelier National Monument; Recommendations For Future Actions During Forest Fires In Areas Containing Cultural Resources; and References Cited.

Descriptors: *Archaeology; *Fire damage; *Forest fires; *Cultural resources; Fire fighting; Site surveys; La Mesa Forest; Prehistoric cultures; Artifacts; Architecture
Identifiers: Bandelier National Monument; NTISDIPSDH
Section Headings: 48D (Natural Resources and Earth Sciences--Forestry); 92D (Behavior and Society--Education, Law, and Humanities)

Fire Management Issues

BLM Utah RAC Subgroup Report on Fire Rehabilitation

12/14/2000 Kirk Halford
Search of the internet for information on fire effects AND archeology:
2 items
1.) http://www.ut.blm.gov/rehabsub.html#5 - Cultural

BLM Utah - Fire Rehabilitation Program

RAC Subgroup Report on Fire Rehabilitation

by
James E. Bowns, Subgroup Chair

PREAMBLE

In the last five years, as a result of wildfires, there has been a dramatic increase in the number of acres burned in Utah. On lands administered by the Bureau of Land Management (BLM) wildfires increased from 4,549 acres in 1991, to 308, 457 acres in 1996 (BLM Facts & Figures for Utah). The 1996 fires resulted in the loss of perennial vegetation over large areas of arid and semi-arid ecosystems in Utah.

This increase is the result of several factors including low precipitation, extremely low vegetation fuel moisture, past policies of controlling all wildfires, the lack of perennial vegetation, and the invasion of cheatgrass and other introduced annual weedy species that are highly flammable.

Rehabilitation of these lands became a public issue when various groups disagreed on whether treatment methods disturbed cultural resource values or the burned site required treatment. Several issues were discussed with the Resource Advisory Council (RAC), who then decided to form a Subgroup to look into the matter. The following issues were considered by the Subgroup.

Issue #1 - Vegetative Rehabilitation and Management of a Burned Area
Issue #2 - Knowledge and Experience
Issue #3 - Methodology
Issue #4 - Native Verses Non-native Seed
Issue #5 - Cultural Resource Inventories
Issue #6 - Cultural Resource Significance
Issue #7 - Native American Coordination and Consultation
Issue #8 - Treatment of Cultural Resources

ISSUE #1 - Vegetative Rehabilitation and Management of a Burned Area

Is it better to seed the area or to allow it to recover naturally through the successional process?

Since fire is a natural phenomenon and component of ecosystems, the first questions considered by the RAC Subgroup were "When considering soil, water, plant and animal resources, should burned areas be allowed to respond naturally or is fire rehabilitation justified? Has the invasion of cheatgrass and other non-native species altered the recovery process?"

ANALYSIS

Utah and other areas of the West have a diversity of ecosystems that respond differently to burning. Some ecosystems require fire for their maintenance (i.e. chaparral) and others may be very sensitive to burning. How ecosystems respond is determined by when the fire occurs (spring, mid-summer, fall), the intensity of the fire (which is dependent upon fuel loads, relative humidity, wind, air temperature), and the composition of the existing plant community, including weeds, at the time of the fire.

How areas recover from burning is largely dependent upon what native or naturalized plant community is in place at the time the fire occurs. If a sufficient understory of perennial grasses, forbs and shrubs is present prior to burning then the plant communities normally recover without reseeding. However, in many situations the herbaceous or shrub communities have been removed by competition from pinyon-juniper communities (P-J) or sagebrush encroachment, overgrazing by livestock and big game, weed infestations, or climatic changes. Under these conditions sufficient native plants are not present to protect the site, or facilitate secondary successional recovery processes and will require seeding of desired species. Fire may be used in such areas as an opportunity to reestablish natural diversity.

Soil, Water, Vegetation

The overriding concern of fire rehabilitation is to conserve the soil and maintain the site. It is well recognized that management goals must be designed to protect the three basic resources of soil, water and vegetation. It is also generally accepted that it requires centuries or millennia to develop an inch of topsoil in arid regions. In addition, recovery of native communities may also require extended periods of time to fully develop. Invasion of weeds can greatly inhibit this process and alter the eventual composition over extensive areas.

Annual plants grow erratically from year to year and are less capable of protecting the soil, throughout the year. Lack of suitable and stable plant cover results in increased rates of wind and water erosion, and a depletion of soil microflora and fauna that are prerequisite to healthy soils and plants. Adapted perennials, with more diverse rooting capabilities, are better able to stabilize soils, retard the frequency and intensity of fire, compete with undesirable species and continue the soil building process. Seedings, consisting of perennial grasses and shrubs, provide a more stable and effective cover than annual weeds. In addition, these seedings restrict weed invasion, and reduce the incidence and size of fires.

Weed Invasion

Weed suppression and control is now a national issue and is receiving attention from the highest levels of government down to the county, city, and individual land owner levels. In many P-J sites the exotic or introduced alien cheatgrass is the pioneer species that occupies the site. In many situations, this plant and other weeds have invaded P-J sites prior to burning. As these weed infested sites burn, the weeds flourish and become more dominant. Cheatgrass is a particularly aggressive winter annual that quickly dominates new disturbances and effectively out-competes seedlings of native species. Consequently natural succession or recovery is delayed, significantly altered, or stopped.

Cheatgrass is also extremely flammable and it considerably alters the intensity and frequency of fires. Fire frequency was originally on the order of every 70 to 100 years or longer. Once these sites are occupied by cheatgrass, fire frequency has changed to every 3-5 years, or at least to more frequent intervals. In addition to increasing fire frequency, cheatgrass has also had an affect on the number of acres consumed by fire. Large contiguous areas are now dominated by this highly flammable weed. When a fire starts on a dry cheatgrass site, the area is quickly consumed. The spread of the fire is rapid and the burned area becomes extensive. If these burned areas are not treated, cheatgrass and other weeds will invade as well, ever expanding their domination of the landscape. Cheatgrass monocultures are now established in extensive portions of the Great Basin, Snake River Plains, Northern & Central Nevada, and the Pacific Northwest. Other exotic annual grasses occupy areas throughout the southwest, including southern Utah, southern Nevada and southern California.

Sites dominated by cheatgrass may have crossed a threshold and succession may not proceed toward the original community or succession will be very slow. This situation that mandates reseeding with adapted species to stabilize the site, prevent soil erosion and prevent the establishment of cheatgrass and other weeds.

On cheatgrass dominated sites there is a much greater opportunity for other secondary weed species to invade and contribute to the degradation of the site. These weed species include, but are not limited to, the Knapweeds (several species), annual mustards (several genera), Medusa-head rye and other annual grasses, scotch, musk and other thistles, skeleton weed, and tumble weed. These species can gain a foothold on cheatgrass sites and eradication becomes extremely difficult or impossible.

Weed invasion can best be prevented or slowed by the reestablishment of perennial communities. Seeding of adapted and desired perennials is most important, but weed control may also be a necessary adjunct to seeding.

Healthy plant communities must maintain their resistance to and resilience from uses and disturbances such as grazing, fire, drought, insects, etc. Plant communities that become dominated by annuals such as cheatgrass lose that ability. When this occurs, range sites are no longer capable of producing diverse plant and animal populations.

SUBGROUP RECOMMENDATIONS

The main objective of fire rehabilitation must be the protection of the basic resources of soil, plants, and water. If an adequate perennial plant community is in place at the time of burning the normal succession process should allow for natural recovery. When a sufficient understory is lacking there will usually be a need for seeding.

The establishment of a perennial community is essential for preventing the establishment of exotic annual weeds. It is critical that seeding be completed within the window of opportunity or annuals will likely dominate the site and fire frequency and intensity will be drastically altered. It is imperative that primary weeds, like cheatgrass and other secondary weeds not invade and cause further site degradation.

ISSUE #2 - Knowledge and Experience

The RAC Subgroup was asked to evaluate whether the BLM employees on-the-ground had the knowledge and experience necessary to be given, or to continue, the task of rehabilitating burned areas.

ANALYSIS

It is recognized that fire management expertise can be spread very thin during catastrophic fires such as those experienced in 1996, so additional and upgraded training and certification of reclamation specialists should be a top priority.

It was suggested that University programs may have become overzealous in teaching range management philosophy and are not effectively teaching the practical aspects of soil, water, plant, and animal management. Emphasis should be placed on experience and practical knowledge, as well as, the dissemination of information.

Some BLM managers, especially those in areas which experience frequent fires, have the knowledge and experience to conduct effective rehabilitation projects. Others may lack experience (in areas where fire is not frequent), or not be current in plant material availability, agronomic practices and the use of animals to manipulate vegetation. These basic skills are not as prevalent in the land management agencies, or society in general, as they once were. The Subgroup suggests that deficiencies in these areas could easily result in a lack of public confidence and support. Also there is concern that political correctness and special interest pressure may be substituted for proper resource management decisions.

The Subgroup recommends that a core of specialists receive regular training in the area of plant species selection which includes adaptations to specific sites, seed characteristics, etc., of native and exotic species. There should also be a greater understanding of methods of seeding, seedbed ecology, site preparation and seeding equipment, ecological site delineation, range improvement techniques and equipment, and GIS mapping. BLM should develop or support training and certification to help develop, inspect, direct, approve and monitor restoration projects.

Considerable knowledge is available on individual plant communities, and species. This current information should be assembled and made available to land managers. At least one subgroup member felt this information is poorly assembled and not updated, and managers fail to use what data is available.

A contract has been awarded to Utah State University to gather data relative to fire rehabilitation. Results of this effort will be distributed to all employees involved in the Emergency Fire Rehabilitation program. See the folio database on Fire Effects on Rangelands in the Great Basin and Colorado Plateau Regions of Utah: An Annotated Bibliography.

A national BLM Fire Rehabilitation Workshop was held in Salt Lake City on October 21-23, 1997. Agenda items included: update of VEGSPEC rehabilitation database; effects of fire & rehabilitation on microbiotic crust; modifications of the rangeland drill to improve seed distribution; seeding equipment availability & ordering; seed requirements & ordering through the regional seed warehouse; rehabilitation studies on Colorado fires; aerial seeding & chaining/harrowing on the Foothills Fire, Idaho; rehabilitation monitoring needs, strategies and status; contracting; Utah large scale wildfire & rehabilitation problems, successes and failures; weed invasion and treatment following wildfire; use of the herbicide 'Oust' before seeding; new technologies for rehabilitation; Wyoming sagebrush reseeding; forage Kochia; EFR handbook presentation on changes; and Clean Water Act compliance. A panel discussed: Native Versus Non-Native species in EFR Program (panel representatives from research, conservation group, livestock industry, academia, land management agency, etc.).

The Subgroup found that BLM is currently updating fire restoration procedures, direction and guidelines. Fire management will be included in the land use planning process prior to burning.

SUBGROUP RECOMMENDATIONS

The Subgroup recommends that funding and resources should be provided to better evaluate and monitor rehabilitation projects. BLM direction has recently been changed to allow funding for monitoring rehabilitated areas for up to three years and be charged to the approved rehabilitation plan.

Expertise in rehabilitation is often spread thin, so it is necessary to provide additional upgraded training and certification. Emphasis should be placed on practical knowledge and experience. There is a need for regular training in the selection of plant species adapted to specific sites, methods of seeding, ecological site evaluations, etc.

Current information should be assembled, updated and made available to field personnel. Managers should be encouraged to attend symposia and workshops specifically related to this subject.

Fire management should be included in the land use planning process and monitoring should be a major part of rehabilitation plans.

ISSUE #3 - Methodology

The Subgroup was asked to consider if BLM is using the best science available when rehabilitating areas burned by wildfires. Different treatment methods were evaluated at several sites.

ANALYSIS

Rehabilitation following wildfires may involve the following: using seed mixtures adapted to the site; drilling seed; broadcasting seed from aircraft without covering it; broadcasting seed followed by dragging a chain to cover the seed; construction of waterbars to reduce erosion; fencing, to keep livestock off rehabilitated areas until plants have established; and, monitoring to evaluate successes or failures.

Seeds of all species require specific seedbed conditions in order to germinate and develop healthy seedlings. Seeds of most species must be covered in order to be adequately stratified, break dormancy, support germination and assure seedling establishment.

Drilling seed

The standard rangeland drill that has been used for the past 50 years has not been upgraded with features that are available on some newer models used in agriculture. Some newer drills have separate seed boxes that are equipped with depth control devices that can be adjusted to the desired seeding rate and depth for each species used. Although such seed drills are available, they are expensive and are not generally in circulation. Upgrading of equipment is expensive and will require special emphasis from management and research agencies. Since newer drills are not available, BLMers feel fortunate to have access to the old drills when a project is done.

Drilling seed has been found to be highly effective when soil, slope, and obstacles are not limiting.

Broadcast seeding, without covering the seed

Few species can establish if placed and left uncovered on arid or semi-arid soils that dry quickly and do not remain moist for extended periods. Visits to sites that were aerial seeded, without any seed coverage, confirmed that this practice was not acceptable on these soils and where soil erosion is a factor. Very little of the uncovered seed had germinated, and what did germinate was not sufficient to protect the soil. The Subgroup found that it is not advisable to broadcast seeds upon the soil surface without some means of covering the seeds. On the other hand, great care should be taken to assure that seed is not placed too deep in the soil. Most grass seed should not be planted deeper that ½ inch.

Broadcast seed, followed by covering the seed

It was found that dragging a chain over the burned and seeded area adequately covers seed. Using a chain to cover the seed allows for surface tillage to be easily regulated. This can be accomplished by using different sized chains, use and positioning of swivels, operational speed, configuration of the chain or using a modified chain such as the "Ely" chain or "Dixie" sager. This treatment is especially useful on harsh, steep slopes where seedling establishment is critical to prevent erosion.

This method has versatility for varying surface tillage by: using different sizes of chains; the use and positioning of swivels; varying operation speed and chain configuration; and, using a smooth, "Ely"chain, or "Dixie sager."

A distinction must be made between the chaining of live trees and covering seed on areas where trees and shrubs have been killed by fire.

Broadcast seeding uses a higher rate of seed, so there is a better chance that each species will find its ultimate niche. Most members of the Subgroup found that rolling a chain over the seed, created adequate seedbeds for mixtures of seed. And they concluded that covering the seed in this manner may be the only method that can achieve the objectives in a cost effective and practical manner when vast acreages are to be seeded. There are many areas of BLM administered land that is too rough or too steep for drilling. An invited Scientist who adamantly opposes chaining of live trees, agreed that covering the seed with a chain is an acceptable and effective method of rehabilitation where trees and shrubs have been killed by fire.

Alternative treatments

One alternative treatment suggested to BLM is hand cutting of trees and distributing tree limbs on the soil surface. Cutting dead or burned tree skeletons is very labor intensive and placing these on the soil surface does not provide an adequate seedbed and does not cover the seeds. The Subgroup felt this practice has limited application.

Another suggested alternative treatment is using livestock to trample the seed into the ground. While this may be effective in small areas, the disadvantages discussed include: the size of the burned area needing treatment; availability and control of the livestock; lack of food available for the livestock on the burned sites; and the ash turning the animals (wool) black. This was discussed among various groups, but not included in the written response to the 20 questions.

SUBGROUP RECOMMENDATIONS

Rehabilitation of wildfires should include: the use of suitable seed mixtures; drilling seed; broadcasting seed without covering it; broadcasting seed and dragging a chain to cover the seed; construction of erosion control structures; fencing for managing livestock; and monitoring.

BLM should purchase and have available the state of the art range drills. These new models provide separate seed boxes for a variety of plant seed. Control of dispersal rates and depth of planting are advantages of this new equipment.

Seeds of most species must be covered in order to assure establishment. Dragging a chain over burned and seeded areas is a suitable technique for covering seed. Chains are useful on rocky soils, harsh or steep slopes where plant establishment is critical for controlling erosion. Using the chain can achieve the objectives in a cost effective and practical manner when large acreages are to be rehabilitated. Alternative methods to using a chain are often too labor intensive, expensive or impractical for a variety of reasons.

ISSUE #4 - Native Verses Non-native Seed

The use of and distinction between native and non-native species is currently a very contentious issue.
Therefore it was addressed by the Subgroup.

ANALYSIS

The main objective of fire rehabilitation is to establish an ecologically sound and functioning perennial plant community. It is therefore important to choose species for their ease of establishment, seedling vigor, and persistence. Emphasis should be placed on plant materials that are best adapted and capable of protecting the basic soil resource.

Considering the established presence of non-natives such as cheatgrass and State listed noxious weeds, keeping a site "natural" seems to be a moot point. Subgroup members pointed out that many dryland and irrigated species currently grown in North America have been introduced from foreign countries in the last one hundred and fifty years.

As a general rule, areas of higher moisture and elevation, deep soils, moderate conditions, and conservative grazing use, respond well to seeding native species. Arid, harsh sites common to BLM lands impacted by heavy domestic and wild animal use, weed invasion and other disturbances may not respond favorably to seeding natives. There are introduced species, and cultivars developed by the USDA Agricultural Research Service and Universities, that are vigorous and establish good stands on harsh sites. Native species that establish well at higher latitudes may not be as successful at our southern latitudes.

The Subgroup suggests that BLM, in cooperation with the seed industry, aggressively adopt a program to develop, produce and use native species on sites where they are adapted and can be expected to thrive. After identifying key native species, seed collectors and marketing companies should be encouraged to produce the seed.

Until more native seed becomes available BLM should use a mixture of native and introduced species. The introduced species can act as a nurse crop, holding the soil in place, and controlling weed invasion, until the native species can again become established.

BLM maintains a seed warehouse in Boise where seed is prepurchased and stock-piled each year before the fire season. In a "normal" fire year, this seed is usually adequate for most of Utah's seed needs. In 1996 large quantities of additional seed were needed, so it was necessary to go out for bids. Adequate amounts of native seed were not available and substitutions had to be made.

The Subgroup recognizes that cost should be a consideration in the selection of plant materials, especially if there is a trade off between total acres treated versus a highly expensive native seed mix.

At higher elevations with more precipitation, deeper, better developed soils, and other more desirable conditions, native species respond well. Arid, harsh sites typical of BLM lands with heavy ungulate use, weed invasion or other disturbances may not be as suitable for native species. On the other hand, selected species and cultivars establish on these harsh sites. Also, native species that establish well at northern latitudes may not be as successful as southern latitudes.

SUBGROUP RECOMMENDATIONS

The major concern must be to maintain ecologically functioning perennial plant communities. Seeded species should be selected for ease of establishment, seedling vigor and persistence in the community. Emphasis should be placed on those plants that are best suited for the site in question. Species selection must be made at the local level by qualified personnel on a site specific basis.

A pre-inventory of expected needs and a proactive program of encouraging the collection and storage of native seed should result in quantities adequate for a "normal" fire year at reasonable cost.

Guideline #5 of Utah's Standards for Rangeland Health and Guidelines for Grazing Management (May1997) addresses this issue and states, "The use and perpetuation of native species will be emphasized. However, when restoring or rehabilitating disturbed or degraded rangelands non-intrusive, non-native plant species are appropriate for use where native species (a) are not available, (b) are not economically feasible, (c) cannot achieve ecological objectives as well as non-native species, and/or (d) cannot compete with already established non-native species."

ISSUE #5 - Cultural Resource Inventories

In accordance with the requirements of Section 106 of the National Historic Preservation Act of 1966 (NHPA), federal agencies must make a reasonable and good faith effort to identify any cultural resources which may be subject to impact from the proposed action and which may be eligible for inclusion on the National Register of Historic Places. The potential impact of the proposed action must be considered by the federal agency official prior to making a decision which could impact those resources.

Given the limited windows of opportunity to conduct effective fire rehabilitation efforts, cultural inventories must be compressed into a very short time frame: after the fires are extinguished but prior to rehabilitation. What opportunities exist to streamline the inventory process?

ANALYSIS

As a direct result of the 1996 wildfire season, considerable informal discussion and debate has occurred around the nation on this subject. Formal discussion of this issue has resulted in recommendations from the Utah Professional Archaeological Council , Mr. Mark Stuart representing the Utah Resource Advisory Council, and others. While the several recommendations vary in detail, there seems to be consensus that opportunities to streamline exist in two major areas:

1) Field methodologies should be streamlined to allow more efficient utilization of staff resources, whether these are in-house personnel, volunteers, or contractors. Location, external site boundaries, and a brief characterization of the resource should be emphasized.

2) There has also been discussion concerning the use of available human resources - including volunteers and contractors. All of these choices have benefits and drawbacks based on start-up time, cost, and availability. Use of each or all should be considered on a case-by-case basis. Relatively small acreages proposed for rehabilitation can be inventoried using in-house personnel and well trained volunteers. As fire size increases, or as the number of fires subject to rehabilitation increases, BLM should increasingly rely on contract efforts. Start-up time for contract work can be minimized by preparation of basic contract packages prior to the fire season.

It is important to reiterate that while there is no legal or regulatory definition of an adequate inventory, the NHPA anticipates that inventory will be sufficient to locate properties that may be eligible for inclusion on the National Register. BLM policy is to conduct Class III, 100% inventory where circumstances suggest that complete physical inventory is needed to locate all eligible properties. As an inventory database emerges through time, it may be possible to determine that certain areas, usually defined by landform or environmental conditions, exhibit a paucity of eligible properties; once these areas are identified, inventory standards may either be reduced or waived in consultation with the State Historic Preservation Officer (SHPO). Sampling, or Class II probabilistic inventory, may be appropriate in limited circumstances.

SUBGROUP RECOMMENDATIONS

A reasonable and good faith effort must be made to identify any cultural resources that may be impacted by the proposed action and which may be eligible for inclusion on the National Register of Historic Places. The potential impact of fire rehabilitation must be considered.

Field methodologies should be streamlined. Location, external site boundaries, and a brief characterization should be emphasized.

The use of all available human resources provides choices that have benefits and drawbacks. Use of each should be considered on a case-by-case basis. Small acreages can be handled with in-house personnel and qualified volunteers. On large fires, BLM should rely on contract efforts. More reliance should be made on pre-fire contract packages.

It may be possible to determine that certain areas, usually defined by landform or environmental condition, exhibit a paucity of eligible properties. Once these areas are identified, inventory standards may be reduced or waived.

Sampling, or class II probabilistic inventory, may be appropriate in limited circumstances.

ISSUE #6 - Cultural Resource Significance

Significance of archaeological and historical resources found on the public lands subject to fire rehabilitation efforts has been the focal point of considerable debate and discussion. What constitutes significance? While this is clearly an important issue, it must be understood that for the purposes of agency compliance with Section 106 of the National Historic Preservation Act, certain legal definitions exist and must be employed.

In the context of the NHPA, a cultural resource or site or property has significance if it is eligible for inclusion on the National Register, and by definition a significant site is eligible for inclusion on the National Register . For our purposes, the two terms, eligible and significant, are interchangeable. The National Register criteria for evaluation are reproduced below from federal regulations at 36 CAR Part 60.4:

"The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and

(a) that are associated with events that have made a significant contribution to the broad patterns of our history; or

(b) that are associated with the lives of persons significant in our past; or

(c) that embody the distinctive characteristics of a type, period, or method of construction,or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) that have yielded, or may be likely to yield, information important in prehistory or history.

Prior to authorizing an action which may result in an effect to any cultural resource, the criteria for evaluation must be applied to all of the resources located during the identification (inventory) stage of work. At a minimum, determinations of eligibility for inclusion on the National Register must be reached in consultation between the federal agency and the State Historic Preservation Officer. In the event of disagreement between the parties to consultation, formal determinations may be deferred to the Keeper of the Register in Washington, DC. A great deal of effort is required to complete this consultation process. A narrative report describing the inventories and the results of the inventories must be prepared; a formal site record must be prepared, with detailed information, for each cultural resource site located during the inventory. The criteria for evaluation must be applied to each resource, discussed in the report, with the agency determinations for eligibility. As a rule of thumb, it takes at least as many days to write this type of report as it does to complete the physical inventory.

It is important to note that cultural efforts conducted after the 1995 and 1996 wildfire seasons on BLM lands in Utah were streamlined considerably. To avoid a protracted effort to prepare reports and site eligibility evaluations on hundreds of sites, BLM and SHPO agreed to a flag-and-avoid procedure. Sites were recorded in the field and flagged for avoidance. As soon as the physical inventories were completed, authorization to commence rehabilitation work (drill seeding or chaining) was issued; reports describing the inventories were to be submitted at a later date. It was necessary to avoid all of the cultural sites, since there was no time for consultation with SHPO on eligibility.

Avoidance (flagging) procedures present another problem which has yet to be resolved. As has been discussed at some length, flagging also serves to identify the sites for possible vandalism. Another drawback to avoidance procedures is the simple fact that avoided sites are not effectively re-seeded; these sites may develop cheat grass and other noxious weeds, and may be more prone to surface erosion, and these sites become obvious because of the cheatgrass. Anecdotal information available from the 1996-97 rehabilitation efforts suggests that in some areas, at least, erosion of archaeological sites in avoidance areas has resulted in site damage.

One option would be to pursue chaining and/or drilling over as many sites as possible to limit the acreage available to cheat grass, to minimize the number of sites exposed to erosion, and to minimize the exposure of sites to vandalism. Archaeologists are not uniform in their views, however, and an opposing viewpoint exists which suggests that rehabilitation areas should be minimized to the extent possible, that larger areas should be in avoidance zones where the sites would blend in to the surroundings and not be keyed out by close flagging. Some individuals argue that chaining and drill seeding are not necessary and that the burned areas will recover with no seed bed preparation or soil cover. These factions argue that the rehabilitation efforts cause more damage to the environment, and an unjustifiable threat to the cultural resources.

There are no easy answers. Recommendations from BLM professional staff, the Utah Professional Archaeological Council, Mr. Mark Stuart of the Resource Advisory Council and others have suggested that additional efficiencies could be gained by investing in research to determine in advance what types of cultural sites might be considered eligible, and which ineligible, for inclusion on the National Register. If a series of clear, well understood thresholds for eligibility could be defined for a region or series of regions subject to wildfire, it might be possible to develop an agreement where field crews would be able to assess eligibility in the field, and to determine which sites should be protected. In turn, fewer avoidance areas on any rehabilitation project would increase the acreage available for re-seeding, and reduce the human efforts necessary to assure site avoidance, reduce erosion on sites, etcetera.

An additional benefit to accrue from research into eligibility issues would be the opportunity to apply the best available science in a careful, thoughtful manner. Resource management decisions which balance the needs of cultural resource protection and preservation against the needs of natural resource conservation could be given more consideration, before the fire season and not as a result of the fire season.

Avoidance (flagging) procedures present problems because it serves to identify sites for possible vandalism. Avoided sites are not effectively seeded, and the sites may revert to noxious weeds and be more prone to erosion.

One option is to pursue chaining and/or drilling over as many sites as possible to limit the acreage susceptible to cheatgrass and minimize erosion and exposure to vandalism.

Another option is to minimize rehabilitation areas so that sites would blend into the surroundings and not be made obvious by flagging.

SUBGROUP RECOMMENDATIONS

Legally, a cultural resource or site or property has significance if it is eligible for inclusion on the National Register. At a minimum, determination of eligibility must be reached in consultation between the federal agency and SHPO. A narrative report must be prepared, and a site record must be prepared for each resource.

Efficiencies could be gained by determining in advance what cultural sites might be considered eligible. This process will help balance the needs of cultural resource protection and preservation against the needs of natural resource conservation.

ISSUE #7 - Native American Coordination and Consultation

Despite BLM efforts to coordinate and/or consult with the appropriate Indian tribes in September and October of 1996, serious Native American concerns surfaced in spring of 1997, with a major effect on the outcome of the BLM rehabilitation effort. What is the role of the Native American people as regards undertakings, or proposed actions, on public lands?

ANALYSIS

Several laws provide clear statutory guidance in this area. The National Environmental Policy

Act of 1969 (NEPA), the Federal Land Policy Management Act of 1976 (FLPMA), the American Indian Religious Freedom Act of 1978 (AIRFA), and the National Historic Preservation Act of 1966 (as amended, NHPA) in concert require BLM to coordinate and to consult with tribes on the full range of land management activities from developing land use plans, through the environmental analysis process, up to and including the land-use decision making process, to determine whether or not agency actions will impact tribal values, religion, culture and or other interests.

Prior to making a decision which may affect tribal interests, BLM has an obligation to contact tribes, coordinate with tribes, and to consult with tribes where appropriate, on the nature and potential impacts of proposed actions, and to consider tribal input, views, and concerns in the decision making process. Additionally, the relationship of the United States government to sovereign Indian tribes is a government-to-government relationship which requires exercise of due respect to the needs of each tribe as regards their form of government and communication needs.

Coordination and consultation with tribal entities is often a time consuming process; the process takes longer when matters of cultural importance are being considered by the tribe(s). Federal agencies like BLM occasionally are pressed to act quickly to resolve resource conflicts, as with the emergency fire rehabilitation actions. Moving quickly to issue a decision on any subject of deep concern to tribal interests, without taking tribal concerns into account, will lead to miscommunication, confusion, and conflict.

Establishing and maintaining a government-to-government relationship based on credibility and trust is the first step in assuring that an appropriate role is available to the Native American community. The nature of the role that tribal entities and Native American people will exercise must be defined by the tribes and by the concerned individuals. The agency obligation is to communicate, coordinate, and to consult in good faith. As an example, it may be appropriate for tribal members to participate with BLM in a wide range of activities, where appropriate and at the discretion of the tribe. Conversely, the tribe(s) may choose not to participate. There are various avenues for improving relationships with tribes and for making the coordination/consultation process more effective and positive. BLM should learn more about tribal concerns, beliefs, and needs, and how those tribal interests are affected by BLM land management. All answers revolve around better communication.

SUBGROUP RECOMMENDATIONS

MOUs and cooperative agreements could be developed to anticipate resource activities, including emergency fire rehabilitation. BLM is legally mandated to coordinate and consult with Native Americans, on the full range of land management activities, to determine whether or not agency actions will impact tribal values, religion, culture, and/or other interests.

BLM must contact, coordinate and consult with tribes on the nature and potential impacts of proposed actions and consider tribal input, views, and concerns. This government-to-government relationship requires exercise of due respect to the needs of each tribe and must be based on credibility and trust. BLM should learn more about tribal concerns, beliefs, needs, and how tribal interests are affected by land management decisions.

ISSUE #8 - Treatment of Cultural Resources

There has been discussion on the appropriate treatment of cultural resources once discovered, in effect, should sites be avoided, should they be seeded, chained or drilled to prevent erosion, and should some sites be treated differently than others?

ANALYSIS

There is no easy answer to this question or questions. Studies are underway by BLM to determine if sites are more likely to be damaged by rehabilitation efforts or by the natural erosional processes or vandalism on sites that ensues where re-seeding is not conducted aggressively. The answers may vary by site type and by soil type, slope, and other factors.

Determinations on how to treat an archaeological or historic site are made by the agency in consultation with SHPO in most circumstances, and in consultation with the President's Advisory Council on Historic Preservation, where appropriate. Interested parties, Indian tribes, and others may participate in this consultation process, but the consultation does not begin until a project or class of projects has been identified.

All options should be considered, once an appropriate level of defensible data has been acquired.

SUBGROUP RECOMMENDATIONS

Studies should continue that will determine if sites are more likely to be damaged by rehabilitation procedures or by the natural erosional process and vandalism on sites where re-seeding is not aggressively conducted. These studies should take into account soil type, slope, and other factors.

Determinations on how to treat an archaeological or historical site should be made by BLM in consultation with SHPO, the President's Advisory Council, interested parties and Indian tribes.

State Director's Response

Fire Rehab Email lmacdona@ut.blm.gov

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2.) http://www.cr.nps.gov/seac/protecting/html/3a-nickens.htm

CHAPTER 3

ARCHAEOLOGICAL SITE DESTRUCTION

> It takes only a period of about a dozen years to implant a basic culture in the mind of man--the period between the age of two and the age of fourteen. In a psycho-biological sense, history, tradition, and custom are only about 12 years old (Beardsley Rumi, World Trade and Peace Address, 1945).

THE DESTRUCTION OF ARCHAEOLOGICAL SITES AND DATA

Paul R. Nickens

Introduction

Archaeological sites are widely recognized as being limited in number and nonrenewable, much like several other natural resources. What distinguishes archaeological sites from many of the other resource concerns is their fragility, informational context, and necessary role in the theoretical, methodological and technical approaches for archaeological investigations of the past. Archaeologists and the interested public are acutely aware of the intrinsic nature of this resource base and of the need to protect it, both for wise use for research and preservation of significant resource elements for future generations.

Unfortunately, the characteristics of the archaeological record that make it so valuable also render it highly vulnerable to destructive forces generated from both natural and human origins. Cultural materials that make up the archaeological context range from being highly perishable, capable of being preserved only under the most unusual conditions, to nearly indestructible items such as stone and ceramic artifacts. However, for the archaeologist the spatial and temporal relationships are as important to reconstruction and interpretation of the past as the cultural debris itself.

This article provides a brief overview of the destructive processes which lead to alteration or loss of archaeological sites and data. We need to understand the stresses in today's environment, and we need to be able to predict the severity and rate of loss associated with the various threats. This forum only allows for a superficial examination of the overall situation, but the discussion will provide a background for other articles in this volume which outline various approaches for protecting archaeological sites.

Archaeological Sites as Resources

Before the various forces contributing to loss of archaeological sites and data are examined, a brief review of why archaeological sites deserve protection is beneficial. Historically, archaeological sites have been of great interest and value to the professionals and concerned avocational archaeologists who study the remains and lifeways of past human communities. Many of the larger important sites have also generated interest among the public in their appreciation for things of the past. Over the past few decades our sociey has come to realize that archaeological sites are finite in number and there has been an awareness that vestiges of our cultural heritage are being methodically destroyed, often at an alarming rate. The increasing demands upon our natural resources and the ever growing use of land surface throughout the country have prompted increased concern for the archaeological sites that remain in place.

While the archaeological site is often the center of the concern, we should remember that our concerns are better targeted at a larger picture, which may be designated as the cultural resource base. Lipe (1984) has defined the cultural resource base as "the material things produced by past human activity--the artifacts, manufacturing debris, middens, structures, monuments, and the like, that have survived from some time in the past into the present." Lipe also notes that the landscapes of past cultures may also qualify as cultural resources.

Professional interest in the preservation of such resources lies in the fact that archaeological remains are a limited, fragile, nonrenewable part of the environment, and any disturbance creates irreversible and cumulative impacts. The following quote from an article by Scovill, Gordon, and Anderson (1977:44) succinctly expresses the important characteristics of archaeological resources for the professional community:

> The investigation of the archaeological record of the American continent is the serious and scientific study of humankind over a span of time numbered in the tens of thousands of years. The study seeks knowledge-knowledge to describe, to explain, and to understand the behavior of past peoples and their interactions as integral parts of changing cultural and natural systems. Cultural history, cultural physiography, cultural ecology, and cultural processes are the current emphasis in the anthropological study of the past through the

archaeological record.

Archaeological resources predominantly consist of the physical evidences, or cultural debris, left on the landscape by past societies.... Of high significance to the investigation, analysis, and interpretation of the cultural debris are the local and regional geomorphological sequences, soil composition, and modern biological and botanical baseline indicators. Critically essential to the methodologies, techniques, and processes of studying archaeological resources is the preservation of the undisturbed stratigraphic context of the cultural debris. Directly stated, the cultural debris of this nation's archaeological resources have no value for studying the past once they have been rearranged on the landscape by a bulldozer or a dragline.

These two paragraphs by Scovill and his co-authors clearly convey the feeling of the professionals regarding archaeological sites as significant resources and point to the reasons why protection of these resources is important for those charged with management of the nation's public lands. In addition to protection and wise use of the resource base today, we also need to be concerned with proper stewardship and preservation of resource elements for the future. As noted some years ago in an article by William Lipe (1974), it is highly desirable to save archaeological sites in place whenever possible as opposed to excavating them without consideration of preservation and thereby promoting removal of yet another piece of the rapidly disappearing resource. Lipe's arguments for a conservation ethic within the profession still have considerable relevance today.

An Overview of Archaeological Site Destruction

A number of agents can be identified which, in most cases, result in either damage, alteration, or complete loss of archaeological sites and data when the agent and the resource come into conflict. An outline of these destructive agents is shown in Figure 1. To be sure, additional sources of disturbance could readily be identified and added to the list; however, those categories indicated cover the major threats to the resource base.

Before these categories are examined, some general comments can be offered concerning the various agents of destruction as they relate to site and data loss. The first, and perhaps most obvious, fact is that a large degree of interrelationship exists between the agents and modes of resource destruction noted in Figure 1 in that much association with respect to cause and effect circumstances is clearly evident among the various categories. For example, in some cases recreation on public lands and hobby collecting (or even malicious vandalism) may be considered interrelated activities. In other instances, the two may be quite differentiated. Likewise, a combination of erosion impacts and land reclamation undertakings may create an environmental battlefield with archaeological sites being among those resources caught in the middle.

The agents of destruction under discussion are not in every case completely harmful to archaeological sites and data. For example, many important archaeological sites would go unrecognized if not for natural erosion or human-caused land alteration, or even as a result of the efforts of interested hobbyists. Some of these agents, particularly the human incidental categories, lead to critical funding for data recovery programs when such activities take place on federal or state lands. However, far more archaeological sites are lost to these agents than are preserved, on public and private lands alike. It is well recognized that with the present legal, funding, and management situations, every worthy site cannot be investigated or even saved. On the positive side, though, the impacts generated by certain forms of destructive activities can be mitigated through increased effectiveness of educational and protective programs. Moreover, interest in reducing the effects of vandalism and finding ways to physically protect endangered resources is on the increase and meaningful results should be evident in the near future.

We also need to keep in mind that the archaeological record, by its very definition, is one that has lost important elements of critical information due to various destructive processes. As Michael Schiffer has noted in his various writings (e.g., 1976, 1983, 1987) on the formation processes affecting the archaeological record, cultural materials suffer varying degrees of informational loss as they are transformed from a systemic or ongoing behavioral system to the archaeological context. The rate of loss is especially calamitous for perishable items. Schiffer goes on to point out that the archaeological record may undergo changes which transform cultural materials from one state to another within the archaeological context (e.g., natural erosion or human intervention such as plowing or land leveling), and that the archaeological context may even return to a systemic one when the archaeologist (or vandal) retrieves the cultural materials. Our concern in this discussion is limited to the destructive processes which take place within the archaeological context and, more importantly, the conflicts which arise as the materials come face to face with the systemic contexts of today.

Agents of Destruction

Sources of potential destructive forces for archaeological sites and data come from almost every conceivable source in the environmental setting. The two major categories include those of a natural origin and those associated with human activities on the landscape. The human agents can be further subdivided into incidental and intentional actions.

Natural Agents

Natural processes and events which affect archaeological sites are legion, ranging from the effects of earthworm and crayfish soil mixing to the devastating consequences of volcanic and earthquake events. In between these extremes we find that the activities of various plants and animals and erosive actions of wind, water, and temperature take a great toll on cultural materials in the archaeological context, leading to loss of items and abundant variation in the record. For the interested, excellent descriptions and discussions of these processes as they relate to archaeological sites can be found in Mathewson (1989), Schiffer (1987), Wildesen

(1982), and Wood and Johnson (1978).

Human Agents

Human-caused actions which have harmful effects on archaeological sites and data are also multitudinous and continue to increase in number and magnitude as lands are developed and exploited and the pressures of population expansion increase. By and large, legislative actions at both the federal (see McManamon this volume) and state levels have been enacted to lessen or mitigate the effects of associated impacts to archaeological sites on public lands; however, the problems associated with many types of activities have in no way been totally eliminated. As they pertain to archaeological sites, destructive actions can be divided into two subcategories: incidental and intentional. As noted previously, the various actions which may be listed under either one of these headings are not totally independent of each other. The advent or growth of a land development activity, for example, will surely create a host of interrelated potential impacts, both in the short-and long-term, including, in all probability, a rise in the incidence of vandalism or depreciative behavior.

Incidental Actions

These activities may be defined as those destructive actions associated with the many forms of land development and resource exploitation that take place on the landscape. In other words, the destruction of archaeological sites and data is not the primary motive behind such actions, but the end result is that another part of the archaeological record disappears from the landscape. These activities may be generally categorized as (1) land development; (2) agriculture and land clearing; (3) grazing; (4) land reclamation and flood control; (5) water development projects; (6) recreational pursuits; (7) construction of roads, public utility features and pipelines; (8) mining and quarrying; and (9) industry.

In many cases, the precise effects of these types of land alteration activities have not been quantified; however, it is not difficult to imagine that each undertaking creates special and ultimately harmful results for the archaeological record if allowed to continue unchecked. These impacts lead to either partial or total destruction, or, at best, mixing and displacement of the resources.

Fortunately, the recent emphasis on proper resource management on public lands has brought about a better understanding of the range and seriousness of impacts resulting from such activities. This emphasis has also led to regulated identification and evaluation of archaeological resources in the impact zones and, when needed, effective mitigation of the adverse effects resulting from those impacts.

The body of literature examining the interplay between human occupation and use of the landscape and protection and preservation of archaeological sites and data has grown over the past twenty years as archaeologists have become more aware of the need to better understand the overall effects of such undertakings. Thus we can find references providing data on such potentially destructive and diverse activities as military training (Carlson and Briuer 1986), livestock grazing (Osborn et al. 1987), forest chaining (DeBloois et al. 1975, Haase 1983), river navigation (Gramann 1981), agricultural practices (Ford and Rollingson 1972,Medford 1972, Roper 1976, and Knoerl and Versaggi 1984), reservoir inundation (Lenihan et al. 1981), stream channelization (Schiffer and House 1977), traffic vibrations on prehistoric structures (King and Algermissen1985), fire (Kelly and Mayberry 1980, Noxon and Marcus 1983, and Switzer 1974), and tourism (Gale and Jacobs1987). In spite of these and other studies, many gaps still exist in our knowledge pertaining to the nature of specific impacts on archaeological resources from the various land disturbing activities listed above.

Intentional Actions

Intentional actions which lead to loss of archaeological sites and data are critical in that they are inherently harmful to the resource base, but, in most cases, are guided by motives that are difficult to prevent or control. The worst of these actions, those related to vandalism, are particularly damaging since they lead to destruction without any return of scientific information. Intentional actions causing resource destruction can be subdivided into three categories: institutionalized destruction, predatory vandalism, and malicious vandalism.

Institutionalized Destruction: Some forms of archaeological site and data destruction have been either tolerated or accepted over the years. In this category, we refer to the loss of cultural materials and information that occurs during professional investigation or associated with the management of archaeological resources.

At first, it may appear that to designate the activities of the archaeologist, whose goal it is to retrieve data from the archaeological context and make sense of it, as being destructive is somewhat contradictory. Realistically, however, it must be said that each and every archaeological endeavor leads to the loss of varying amounts of information. This situation will never be completely alleviated since far too many factors are involved (e.g., professional competence, data recovery techniques, and time and funding constraints). Further, we must recognize that a tremendous amount of archaeological data was lost during the early phases of discovery and investigation in this country when zeal often took predominance over scientific discretion. It is, however, difficult to excessively castigate many of those early efforts from our present-day vantage point. Undoubtedly, our successors will at some point in the future decry the "primitive" data recovery and analytical techniques used by archaeologists in the 1980's and 1990's and complain of the data loss which took place.

More to the point at hand, certain archaeological practices, which unfortunately continue to exist, do result in intentional and harmful effects to the resource base. These actions range from survey techniques in which, for example, artifacts are collected without corresponding mapping of artifact loci, to much more serious problems involving the use of limited research designs to guide excavation of archaeological sites. Even more damaging is the act of conducting investigative work and not pursuing the necessary analysis and reporting of the results. It is probably fair to state that in the past and even today some archaeological fieldwork was/is undertaken without any intention on the part of the investigator to adequately analyze the resultant data and make them available. Hopefully, the time is near when well-meaning but overworked investigators are no longer allowed to conduct field work beyond their capacity, professional or financial, to effectively complete the research process. As has been noted by others, this practice is little more than a form of archaeological vandalism.

Similar losses of archaeological sites and data can result from management practices on the part of agencies charged with this responsibility (see Spoerl 1988). Actions leading to resource destruction can include ineffective management orientations, a lack of rigorous evaluation methodologies for evaluating significance of sites, or failure to fully realize the impacts that an agency's activities or operations may have on archaeological resources. Examples of the latter activities might include the side effects from timbering actions or shoreline and downstream impacts to archaeological sites from operation of a reservoir.

Predatory Vandalism: This form of intentional activity is the most widespread and leads to the most serious consequences for archaeological resources (Nickens et al. 1981, U.S. General Accounting Office 1987). It is characterized by a motive dictated by personal gain, either of a noncommercial or commercial nature. In the first case, the effort may involve actions such as adding items to one's collection of relics, satisfying a curiosity about antiquities, or perhaps egocentric autographing of resource sites. Commercial ventures are guided by a motive of retrieving artifacts for sale and profit. In either case, the impact to archaeological resources is much the same, loss of cultural elements and contextual information.

To understand the problem it will be useful to examine its extent as indicated by one study completed a few years ago. In that investigation, Williams (1978) surveyed the management problem of cultural resource vandalism in federal and state agency recreation areas throughout the Rocky Mountain West. In compiling the results provided by resource managers throughout several states, Williams listed the following vandalism practices which impact cultural resource sites (arranged in decreasing order by reported absolute frequency):

Excavation (digging, pothunting, use of heavy machinery)
Carving, scratching, chipping, general defacement
Surface collection of artifacts (especially lithic artifacts)
Removing, shooting at, painting, chalking, making casts and tracings of rock art
Theft of artifacts from structures
Stripping weathered boards or other timbers
Removing part or all of a structure or causing structural damage
Dismantling, general destruction of structure (but apparently no removal)
Arson
Climbing or walking on resources
Building new roads over, using modern vehicles on historic roads, offroad
recreational
vehicle use
Rearrangement of or relocating of resources

Breaking artifacts, objects, windows
Breaking and entering
Knocking structures over
Use as firewood
Throwing rocks into excavated ruin
Handling, touching

Malicious Vandalism: The final category of intentional vandalism includes acts which may be classified as those brought about by revenge or frustration with government policies, or those which result from no discernible motive at all (Chokhani 1979:10). Basically, this category of vandalism includes those inexplicable, unprovoked actions for which there are no avowed motives. Such behavior can be the result of wanton activities, or even the end product of psychotic or inebriate conduct. Fortunately, this type of aggressive vandalism, quite often highly destructive in nature, occurs less frequently in comparison to other forms of vandalistic behavior. An example of such senseless vandalism occurred in 1979 at Arches National Park near Moab, Utah, where a highly significant rock art panel was obliterated by brushing a chemical solvent across the panel face (Noxon and Marcus 1980).

Conclusion

The aim of the foregoing discussion has been to review the various agents which interact to extirpate elements of our nation's archaeological heritage. The importance of maintaining archaeological sites in pristine conditions cannot be understated, nor can the need to provide protection and preservation for the vestiges of this resource. The actions of natural processes upon archaeological sites and the ever-expanding demands by our population on the landscape are agents of destruction that will continue to adversely affect archaeological resources. It is simply not possible to completely halt all the detrimental stresses resulting from environmental processes. The effects of such impacts can, in many cases, be mitigated by using physical protection technologies, given appropriate need and funding. It should be noted that the natural agents of destruction tend to occur more slowly than human-caused actions and therefore may be considered to have a lower overall priority in cultural resource management than those detrimental effects tied to human activities. However, given the amount of past destruction of archaeological sites and data and that continuing today, we cannot afford hesitation on any front of the conservation battle.

While some problems still exist, incidental impacts to archaeological resources as by-products of land alteration and resource exploitation are by and large mitigated by legislative enactments, at least on federal and state lands. Control of vandalism, however, continues to be a formidable challenge. Severe problems continue to be associated with destructive actions on private lands, with the result being that valuable archaeological remains are disappearing at an alarming rate. This fact makes it even more important that such resources on public lands be adequately protected.

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Society for California Archaeology
Fire Effects Symposium Abstracts 1999

Symposium on Fire Effects to Obsidian
Society for California Archaeology
33rd Annual Meeting, Sacramento, California, 1999

Tom Origer and Dave Fredrickson, Organizers and Chairs.
The Effects of Fire/Heat on Obsidian.

For several decades, a number of researchers have examined the effects that fire/heat has on obsidian specimens. Some studies were focused on the after-effects of wildfires, some on controlled burns, and still others on conditions created under laboratory conditions. An understanding of the effects of fire/heat on obsidian specimens continues to gain in importance as land managers increasingly use fire to control fuel buildup in woodlands and forests and alter vegetation patterns (i.e., improve pastureland). This session brings together researchers to describe their work and findings in a setting conductive to discussion, debate, and sharing of information.

Benson, Arlene   Humboldt-Toiyabe National Forest
Effects of Fire on Obsidian Hydration Rind Thickness
In September 1996, ninety obsidian samples were treated to low, moderate, and high intensity fire during a prescribed fire in a high mountain sagebrush environment. Thermocouples were used to record maximum temperatures reached at each sample during the burn. Then control samples were not treated to fire. The obsidian hydration rinds of all 100 samples included in the study were measured before and after the study. Changes in hydration rind thickness of both treated and untreated obsidian samples will be described and implications discussed.

Deal, Krista   Eldorado National Forest
and Denise McLemore
Effects of Prescribed Burning on Obsidian and Implications for Reconstructing Past Landscape Conditions
Hydration bands on surface and near-surface obsidian often become diffused and unreadable following wildfires. The assumption has been that less intense fires, like those prescribed for management purposes, do not reach temperatures that would effect hydration bands, although there has been little data to support this assumption. The current study measured the effects to archaeological obsidian of both temperature and duration of heat in two prescribed burns with differing fuel loads. Preliminary results indicated that duration of exposure to heat, even at low temperature creates effects on hydration bands similar to those of elevated temperatures. These results have potential implications for expanding fire histories beyond the 400-year limit of tree-coring, for reconstructing prior landscape conditions and Indian burning practices, for archaeological interpretations, and for cultural resource and ecosystem management.

Fredrickson, David A.   Sonoma State University
No abstract.

Green, Dee Warner Mountain Ranger District, USDA Forest Service
Re-Hydrated Obsidian Projectile Points on the Warner Mountains, California
Fire is the only known method, in the natural environment, which can remove hydration rinds from obsidian. In cases where early archaic projectile points show hydration rinds which reflect what is thought to be a much later time period, there is a probability that such points have been subjected to fire and then re-hydrated. This paper examines a collection of such points from the Warner Mountains of northeastern California. Distributions of all hydrated points, by watershed, are examined and plotted. The utility of re-hydrated points in studies of fire history is examined.

Halford, F. Kirk (with contributions from Anne S. Halford) Bureau of Land Management
The Trench Canyon Prescribed Burn: An Analysis of Fire Effects on Archaeological Resources Within the Sagebrush Steppe Community
Prescribed fire is becoming a common tool on Public Lands to manage fire behavior, fuel loading, and vegetation community associations. The effects of this management practice on archaeological resources is of concern. This paper will focus on the effects of a prescribed burn on the hydration birefringent rim of obsidian artifacts. In particular, this analysis addresses the differential effects of fire within three quantified fuel zones within late seral Great Basin sage (*artemisia tridentata* spp. tridentata) and upland sagebrush steppe community types.

Kelly, Roger National Park Service
An Overview of Obsidian Studies Within NPS Park Projects
From clumsy field experiments to higher-tech laboratory efforts, National Park Service archeological staff have explored heat effects upon obsidian for nearly two decades. Early assumptions and guesses have lead to systematic and organized data collecting, but mostly post-prescription burns or post-wildlife campaigns. What have we – as one agency – learned about changes or lack of change in obsidian materials as found within several California NPS park units? And also, what about the neighboring NPS park units elsewhere in the West where comparative data exist? Are we working better with our fire program colleagues as a result of greater understanding about obsidian and fire?

Loyd, Janine Sonoma State University Obsidian Laboratory
Rehydration of Burned Obsidian
Obsidian specimens have, no doubt, been exposed to fire during prehistoric and historic times, sometimes deliberately, but most often unintentionally as in the case of wildfires. Three basic questions present themselves when looking at the effects of obsidian having been exposed to fire. Does obsidian lose hydration when it is burned? Does obsidian have the ability to rehydrate after it has been exposed to fire? Does the temperature at which the obsidian was burned effect obsidian rehydration? This paper presents the results of experiments designed to address these questions.

Origer, Tom Sonoma State University.
No abstract.

Schroder, Sue Ann Sonoma State University Obsidian Laboratory

A synthesis of Previous Studies that Explored the Effects of Fire on Obsidian: Where we've Been and Where We're Going
Some 15 unpublished and published documents related to fire/heat effects on obsidian were reviewed. Virtually each document described a different set of procedures that were used to determine whether fire/heat had affected hydration bands. The broad range of study procedures resulted in a shared conclusion – hydration bands were affected by fire/heat in some way. This paper will synthesize and describe analytical techniques and results of prior studies, with the intent of creating a solid foundation upon which future studies can be designed.

Shackley, M. Steven Archaeological XRF Laboratory, Phoebe Hearst Museum of Anthropology, University of California, Berkeley
and Carolyn Dillian
Thermal and Environmental Effects on Obsidian Geochemistry: Experimental and Archaeological Evidence
Recent EDXRF compositional studies of thermally altered archaeological obsidian from a number of late period sites in New Mexico and Arizona suggested that extreme thermal alteration may have been responsible for the depletion of elemental concentrations in the mid-Z x-ray region; a region where the most sensitive incompatible elements for the discrimination of archaeological obsidians reside. A stepped heating experiment subjecting samples of peraluminous to peralkaline artifact-quality obsidian to temperatures between 500°C and 1080°C indicated that at temperatures over 1000°C extreme mechanical changes occur, but the elemental composition in the mid-Z region does not vary beyond that expected in typical instrumental error. It appears that the apparent depletion of elemental concentrations in the archaeological specimens is due to EDXRF analysis of surface regions where melted sands bonded to the surface glass are incorporated into the results. If accurate analyses of burned obsidian artifacts are desired, the layer of melted sand from the depositional contexts must be removed before analysis.

Siefkin, Nelson National Park Service, Redwood National and State Parks
Manual Fuel Load Reduction as a Means of reducing the Effects of Fire on Obsidian Hydration: An Example from Lassen Volcanic National Park
Each of the four National Park Service Units of northern California – Lassen Volcanic National Park, Lava Beds National Monument, Redwood National Park and the Whiskeytown National Recreation Area – have prescribed fire programs which are conducted in areas with radically different vegetation types. As a result, the archeological survey strategy and the assumptions about the effects of fire on obsidain (and other cultural resources), in each unit, differ, as do the protective measures for these resources. In 1998, National Park Service and California Department of Forestry personnel removed a substantial amount of dead and down woody fuel from the surface of a large lithic scatter in Lassen Volcanic. In the absence of funds for obsidian hydration, subsurface testing, and other studies, manual fuel load reduction may be a viable means of protecting obsidian from the effects of high temperature controlled burns and wildfires.

Skinner, Carl N. USFS, Pacific Southwest Research Station
and C. Phillip Weatherspoon

Fire Regimes and Fire History: Implications for Obsidian Hydration Dating

That fire can alter the hydration bands of obsidian specimens and thus affect the accuracy of dating is well known. It is also well known that before the 20th Century, fires were generally frequent (intervals of 5-20 years were common) i most forest, woodland, grassland, and shrub ecosystems of the western U.S. and especially California. Thus, it is likely that obsidian material that has been unprotected for more than a few decades on or near the soil surface has been exposed to fire. Only material that was buried and remained so after it was no longer used is likely to have escaped being influenced by fire. Fire intensity and duration of burning are highly variable and dependent upon the nature of the available fuels and weather conditions. Thus, high variability in dates inferred from hydration rinds should be expected from artifacts that have been exposed to the effects of past fires.

Smith, Jim California Department of Forestry and Fire Protection

Protecting Archeological Sites with Prescribed Fire

Past fire studies have shown that fire has a measurable effect on the hydration rind that forms on obsidian artifacts. Ecosystem management requires the reintroduction of fire through either prescribed fires or to allow wildfires to burn unabated. Wildfires are happenstance, and when occurring in areas where significant archeological resources are located, damage to sites can occur not only through suppression actions but from the unnatural fire intensities generated from accumulated fuel loading attributed to successful fire management practices. Wildfires therefore, do not afford the opportunity for archeologist to successfully protect known and newly discovered sites. Prescribed fire, through proper planning and site surveys, can protect archeological resources and allow the reintroduction of fires as a natural process in fire dependent ecosystems.

Soloman, Madeline Sonoma State University and California Department of Forestry and Fire Protection

Fire and Glass: Experimental Approaches to Understanding the Effects of Prescribed Burning on Obsidian Hydration Bands

During field experiments conducted in spring 1998 at Boggs Mountain Demonstration State Forests in Lake county, California, the hydration bands on obsidian artifacts placed in ground surface and subsurface contexts were not affected by exposure to prescribed burn conditions. Subsequent laboratory experiments at Sonoma State university suggested that gydration bands may not ve affected by prolonged exposure (24 hours) to temperatures of 100°C or below. These findings are considered in light of previous research on the effects of prescribed fire on obsidian hydration bands, and it is suggested that an examination of the specific prescription involved in a proposed burn is an essential factor in determining the likelihood that hydration bands may become damaged during prescribed burning. As additional studies are needed to expand and refine our understanding of the effects of fire on hydration bands, several experimental approaches are proposed and discussed.

Steffen, Anastasia University of New Mexico

The Dome Fire Study: Extreme Forest Fire Effects on Jemez Obsidian

The 1996 Dome Fire burned over several obsidian source locations in Jemez Mountains of northern New Mexico. At one site, Capulin Quarry, the effects of the wildfire on obsidian were remarkably severe – including artifact bubbling, bloating, and complete destruction through vesiculation. This paper presents these effects along with an exploration of why obsidian at this source (Rabbit Mountain / Cerro Toledo rhyolite) had such a volatile response during this forest fire.

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Preface

This bibliography is a by-product of a joint effort between the National Park Service and the USFS Fire Sciences Lab to produce a review of knowledge on fire effects on cultural resources. The main product of the project will be a "Rainbow Series" volume on fire effects on cultural resources and archeology (Jones and Ryan, in preparation). The bibliography does include some references on the historical and traditional uses of fire and on the history of fire. However as an aid to authors of the Rainbow volume, its primary focus is on the direct and indirect effects of heating on various types of cultural resources. Kevin Ryan of the Fire Sciences Lab and Trinkle Jones of Western Archeological and Conservation Center (WACC) deserve credit for making this project possible. Both have been of immeasurable assistance to me throughout my work on this project.

Most literature concerning fire effects on cultural resources is unpublished "gray literature." Many of the references cited in this bibliography are fairly obscure. Over the course of about 13 months, I was able to obtain a great deal of the literature cited here. This material is now on file at the Western Archeological and Conservation Center in Tucson. It will be made available by appointment. The process of collecting this material required the assistance of many people. I called numerous USFS ranger districts and BLM offices, e-mailed several authors and solicited the input of several "pyro-archeologists." Numerous people responded to my e-mails and phone calls; several folks were willing to send me reports and manuscripts to put on file at WACC. Everybody who helped me in this effort deserves a lot of thanks.

Archeologist Trinkle Jones, librarian Johanna Alexander, and I began our searches for fire effects literature with Faith Duncan's annotated bibliography (Duncan 1990). She created a comprehensive list of references on fire effects on cultural resources, which was a tremendous help to our project. Additional references were found by reviewing other bibliographies and reference lists or were submitted by people interested in the subject. Citations were checked for accuracy by obtaining hard copies in-house or at the library or by confirming that a reference was cited the same way by at least two authors. Some of Duncan's references, especially letters, could not be relocated so are not included in this bibliography. To date, the bibliography is available in ProCite and MS-Word formats, and we plan to make it available on the Internet. I hope that this work will be helpful to all those people trying to bring together the worlds of fire, archeology and resource management.

Trisha Rude
Tucson, Arizona
24 April 2001

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